

Employment Aspects of the Transition from Fossil Fuels in Australia

By Dr. Jim Stanford

**The Centre for Future Work
at the Australia Institute**

December 2020

About The Australia Institute

The Australia Institute is an independent public policy think tank based in Canberra. It is funded by donations from philanthropic trusts and individuals and commissioned research. We barrack for ideas, not political parties or candidates. Since its launch in 1994, the Institute has carried out highly influential research on a broad range of economic, social and environmental issues..

Our Philosophy

As we begin the 21st century, new dilemmas confront our society and our planet. Unprecedented levels of consumption co-exist with extreme poverty. Through new technology we are more connected than we have ever been, yet civic engagement is declining. Environmental neglect continues despite heightened ecological awareness. A better balance is urgently needed.

The Australia Institute's directors, staff and supporters represent a broad range of views and priorities. What unites us is a belief that through a combination of research and creativity we can promote new solutions and ways of thinking.

Our Purpose – *'Research That Matters'*

The Institute publishes research that contributes to a more just, sustainable and peaceful society. Our goal is to gather, interpret and communicate evidence in order to both diagnose the problems we face and propose new solutions to tackle them.

The Institute is wholly independent and not affiliated with any other organisation. Donations to its Research Fund are tax deductible for the donor. Anyone wishing to donate can do so via the website at <https://www.tai.org.au> or by calling the Institute on 02 6130 0530. Our secure and user-friendly website allows donors to make either one-off or regular monthly donations.

Level 1, Endeavour House, 1 Franklin St
Canberra, ACT 2601

About the Centre for Future Work

The Centre for Future Work is a research centre, housed within the Australia Institute, to conduct and publish progressive economic research on work, employment, and labour markets.

It serves as a unique centre of excellence on the economic issues facing working people: including the future of jobs, wages and income distribution, skills and training, sector and industry policies, globalisation, the role of government, public services, and more. The Centre also develops timely and practical policy proposals to help make the world of work better for working people and their families.

www.futurework.org.au

About the Author

Jim Stanford is Economist and Director of the Centre for Future Work at the Australia Institute. He holds a Ph.D. in Economics from the New School for Social Research, and an M.Phil. in Economics from the University of Cambridge. He has worked in labour market policy research for 25 years.

This report was prepared for the HESTA superannuation fund. The views expressed are those of the author.

The author thanks, without implication, Richie Merzian and Richard Denniss for helpful input.

The **Australia**
Institute | Centre for
Research that matters. **FutureWork**

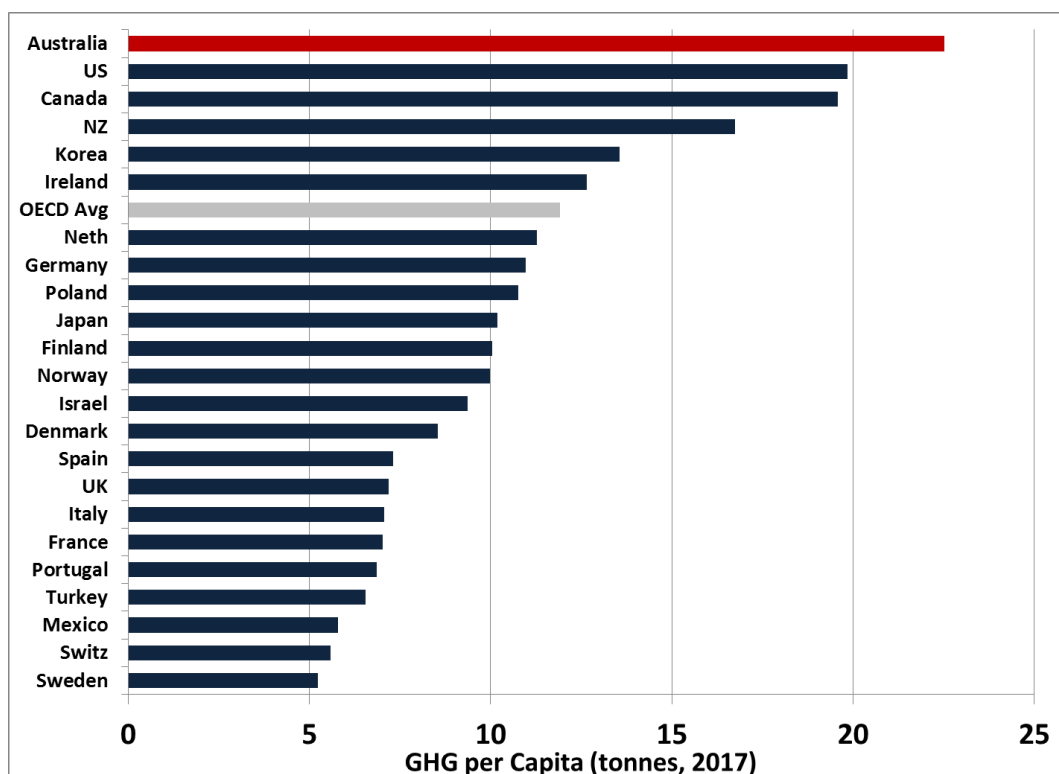
Table of Contents

Introduction: Australia's Responsibility	4
How Many Fossil Fuel Jobs Are There?	9
The Regional Distribution of Fossil Fuel Employment.....	15
Past Employment Transitions in Australian History	18
A Labour Market in Constant Motion.....	22
Other Threats to Fossil Fuel Jobs.....	32
Planning an Orderly Transition	40
Successful Transitions Around the World	48
Good Alternative Jobs: Where Will They Come From?	54
Conclusion: No Time to Waste	59
References	62

Introduction: Australia's Responsibility

Climate change poses a fundamental threat to the well-being and security of people everywhere. And Australia is on the front lines of the challenge. We have already experienced some of the fastest and most intense consequences of climate change, in many forms: extreme heat, droughts, floods, extreme weather and catastrophic bushfires (as in 2019-20). Climate change is no longer an abstract or hypothetical worry. It is a clear and present danger, and we are already paying for it: with more frequent disasters, soaring insurance premiums, and measurable health costs.

Figure 1. Greenhouse Gas Emissions per Capita



Source: Author's calculations from OECD National Accounts at a Glance and OECD Greenhouse Gas Emissions.

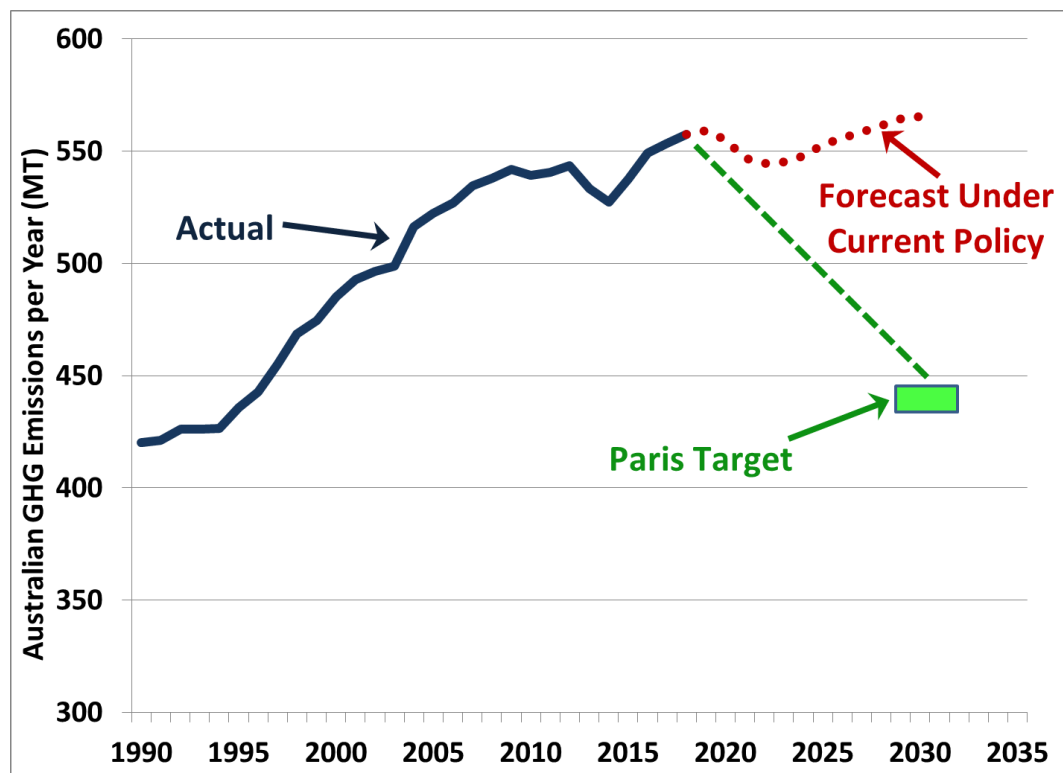
The problem of climate change is global; emissions and pollution do not respect national borders. But to address the global threat, every country must play its part. And Australia has a special responsibility to act, and quickly, for several reasons:

- We are suffering huge costs because of climate change.
- We are a rich country, that can afford to invest in stabilising the climate.
- We are one of the worst greenhouse gas (GHG) polluters in the world.

In fact, as shown in Figure 1, Australia has the highest GHG emissions per capita of any of the 36 industrial countries in the Organization for Economic Cooperation and Development (OECD). Our emissions – around 22 tonnes of CO² equivalent for every Australian – are almost twice as high as the OECD average. We emit 4 times per person more than the average Swede.

Worse yet, Australia has been very slow in addressing climate change with effective and consistent policies. Climate policy has become a political wedge issue, subject to reversals and changes in direction depending on the fleeting political imperatives of the day. After a temporary decline (largely sparked by a short-lived national carbon tax, which was then abolished in 2014), Australia's total emissions have increased again in recent years (see Figure 2). Under existing policies, emissions are projected to stay at or above current levels over the coming decade.

Figure 2. Australian Emissions and Targets, 1990-2030



Source: Climate Action Tracker (2020), Australia Country Summary.

That will leave us far short of the emissions reduction target our government committed to as part of the historic Paris Agreement. Under that treaty, Australia committed to reduce total emissions by at least 26-28% below 2005 levels. That will require a reduction of over 100 Mt (million tonnes) of annual emissions by 2030. The Paris targets are designed to try to limit the rise in global temperatures to less than 2 degrees Celsius (and strive to keep it below 1.5°C) – which in itself will still cause widespread damage and dislocation.

Moreover, it is accepted that countries around the world must do more than those Paris targets, moving toward full net carbon neutrality: that is, so that countries would only emit as much GHG emissions as can be offset by various absorption mechanisms (such as forests and other carbon ‘sinks’). The Paris Agreement aims for carbon neutrality by the second half of this century, and over 70 countries around the world have committed to reach net neutral carbon pollution positions by 2050.¹ Indeed, individually all Australian states have already committed to net carbon neutrality by 2050 – although the Commonwealth government has yet to ratify that goal at a national level. Many important global companies have also adopted targets for net carbon neutrality by 2050.²

Ultimately, meeting our Paris targets and moving to a net-neutral economy will require a full transition away from the production and consumption of fossil fuels – the biggest source of carbon pollution in the world. Fortunately, there are many proven policies and technologies that can reduce Australia’s use of fossil fuels, and hence our greenhouse gas emissions: including faster roll-out of renewable electricity sources, adoption of less polluting or non-polluting modes of transportation, energy conservation measures in buildings and houses, and better agriculture and forestry management. The key barrier holding back progress on this front is not technical or economic. After all, alternative energy sources are now proven to be more cost-competitive than fossil fuels in most applications, including electricity generation and transportation. The main problem is Australia’s failure to implement a consistent and stable policy framework to accelerate the transition to renewable energy sources.

Some voices, in opposing the shift to renewables, cite concerns about economic consequences and job losses arising from the decline of fossil fuel production and use. Australia is a major producer and exporter of fossil fuels (including coal, natural gas, and petroleum). Australian-produced fossil fuels (used at home and abroad, via our fuel exports) account for over 4% of all global fossil fuel GHG emissions – far out of

¹ See Murphy (2020).

² For example, the major companies cited by Geck (2019).

proportion to our 0.3% share of the world's population.³ Phasing out fossil fuel production and use is an essential priority, for Australia and other countries. But many fear what this will mean for Australia's economy and labour market. And some with vested financial interests in fossil fuels exploit these fears to stymie the policy reforms needed to best position Australia for a sustainable energy future.

Those fears are exaggerated. Contrary to popular conception, fossil fuel industries are not a major source of employment in Australia. They account for only 1% of jobs, and their relative importance has already declined in recent years. With appropriate policies to plan orderly transitions, support affected workers and communities as the transition occurs, and ensure strong job-creation in the rest of the economy, the phase-out of fossil fuel industries need not hurt Australia's economy at all. To the contrary, if managed properly the energy transition will generate major benefits in investment, efficiency, and employment – and will ensure we can live in a habitable, sustainable environment.

This report will consider the employment dimensions of the coming transition from fossil fuels to renewable energy sources. It will describe the current scale and regional distribution of direct jobs in fossil fuel industries. It will reveal how Australia's labour market is constantly changing, and show that the scale of change required to phase out fossil fuel use is actually modest relative to other employment transitions in Australian history. It will identify key policy measures which can support an orderly, fair, and efficient transition of fossil fuel employment – without imposing an undue burden on Australians who currently work in those industries, and the communities where they live.

In 2020 Australia's economy entered a serious recession, its first in nearly 30 years, as a result of the global COVID-19 pandemic. This reinforces the importance of job-creation as the top priority for economic policy in coming years. Government will need to provide maximum possible support to job-creation initiatives to assist households, communities, and the national economy in recovering from this historic downturn. Jobs in health care and other human and caring services will be a critical feature of that post-pandemic recovery effort. As described in detail below, human services are relatively labour-intensive: they support far more jobs per million dollars of output than fossil fuel industries. Therefore, for reasons of economic recovery as well as public health, the inevitable transition away from fossil fuels can be reinforced by greater investments in coming years in health care and other vital services.

³ Swann (2019).

The transition away from fossil fuels is going to occur: there is no longer any scientific doubt about that. It is our choice whether we move quickly to make that transition an orderly and effective one – or we stand back until we are overtaken by global economic and environmental forces, and experience a transition that is far more chaotic, disruptive and expensive.

In short, worries about losing fossil fuel jobs should not slow down Australia's progress through this inevitable transition. To the contrary, if we truly care about those workers and communities, we should announce the transition clearly, provide years to achieve it, and support those affected with a suite of generous measures: including retirement and voluntary severance incentives, retraining and relocation grants, income protection, and regional diversification strategies. Far from being 'supportive' of fossil fuel workers by attempting to disrupt and delay appropriate climate transitions, in fact it does them a great disservice to pretend that these industries have a long-term viable future. It seems a cruel hoax to encourage young workers to begin their careers in industries with an inevitably short time horizon. It would be more compassionate and honest to give fossil fuel workers (both current and prospective) fair notice of the changes coming, and support them in building careers in occupations and industries that are ultimately more promising.

Australia can absolutely achieve vibrant, strong, inclusive and fair labour market outcomes, even as we replace fossil fuels in our employment and economic mix. Done right, this transition will produce a stronger labour market, and a better future.

How Many Fossil Fuel Jobs Are There?

Fossil fuel industries are often portrayed as the ‘engine’ of Australia’s economy. Mega-investments in coal mines, LNG plants, and other huge facilities – mostly oriented around export shipments – generate front-page coverage in newspapers, and win top-priority attention from political leaders. In actual fact, however, fossil fuel industries account for a very small proportion of total employment in Australia.

Table 1		
Fossil Fuel Employment, 2019 (000)		
	2019	Change from 2012
Coal Mining	52.1	2.0
Oil & Gas Extraction	28.1	11.2
Coal & Petroleum Refining	7.9	-3.4
Electricity Supply*	33.2	-1.6
Gas Supply	11.9	-0.7
Total Fossil Fuel	133.1	7.5
Australia: All Industries	12893	1575
Fossil Fuel Share	1.0%	0.5%
* Includes 50% of electricity industry employment, excluding assumed 50% share for other generation sources plus transmission, infrastructure, service and overhead.		

Table 1 lists current employment in 5 key segments of fossil fuel production and use in Australia, on the basis of ABS Labour Force Survey data.⁴ This includes the extraction of fossil fuels (coal, oil and gas), their refining and processing, and their distribution to consumers (via fossil fuel-powered electricity⁵, gas pipelines, etc.). None of these

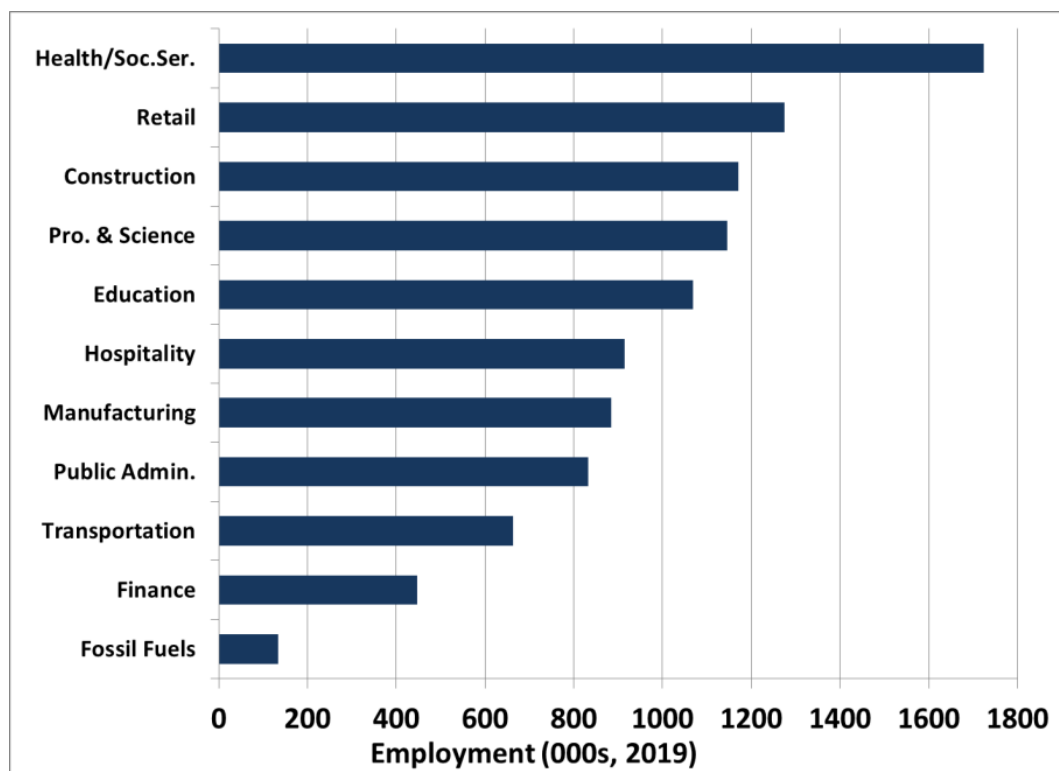
⁴ Quarterly statistics are reported in ABS Catalogue 6291.0.55.003, Table 6, and include self-employed. Data in Table 1 are calendar-year averages for 2019.

⁵ The estimates below ascribe half of electricity sector employment to fossil fuel-associated activities, and the other half to alternative sources of generation, as well as jobs in transmission, distribution and administration. As electricity generation continues to shift toward renewable sources, most jobs in the system will still be required (even if jobs disappear from some fossil fuel-based facilities), so this assumption overstates the true extent of fossil fuel-related employment in the electricity system.

sectors is a large employer in the context of Australia’s overall economy – which employs some 13 million people in total. Coal mining is the largest single fossil fuel activity, employing around 50,000 Australians.⁶

These 5 sectors together directly employed 133,000 people in 2019. That is about 1% of Australia’s total employment. Moreover, there have been very few new jobs created in fossil fuel industries in recent years. Combined employment in those 5 sectors grew by 7500 positions in the period from 2012 through 2019: about 1000 new jobs per year. That represented only 0.5% of total job creation in Australia in that period (compared to the total of over 1.5 million new jobs created over the same period total). Thus the share of fossil fuel jobs in total employment is already declining.

Figure 3: Australia’s Biggest Employers



Source: ABS Catalogue 6291.0.55.003.

⁶ Other statistical sources suggest coal mining employment is considerably smaller than this; for example, ABS Labour Account data (Catalogue 8155.0, Table 2) reported just 36,000 employees in coal mining in 2017-18. So Table 1 likely overstates true fossil fuel employment. Over half of Australian coal is extracted for metallurgical purposes (for producing steel and other primary metals), and the rest is used in thermal applications (mostly for generating electricity). Thermal coal can be easily and cheaply replaced with sustainable energy sources; carbon-free alternatives for metallurgical coal are being developed and trialed, but it will take longer for those alternatives to become widespread.

The modest size of fossil fuel employment is especially obvious when compared to bigger industries which fill a more genuinely important role in Australia's labour market. Figure 3 illustrates employment in Australia's 10 largest industries in 2019, in comparison to fossil fuel jobs. Those 10 industries alone employed over 10 million Australians (an average of 1 million each). Normal swings in employment in those large sectors will dwarf any changes in fossil fuel employment.

Indeed, the Australian economy has created an average of 270,000 new jobs per year over the past 5 years. In any single year, therefore, the economy produced twice as many *new* jobs, as are employed *in total* in fossil fuel production and use. In that context, it is obvious that the economy is very well able to reallocate employment away from fossil fuel industries. (More details on how to fairly and effectively manage that process are provided below).

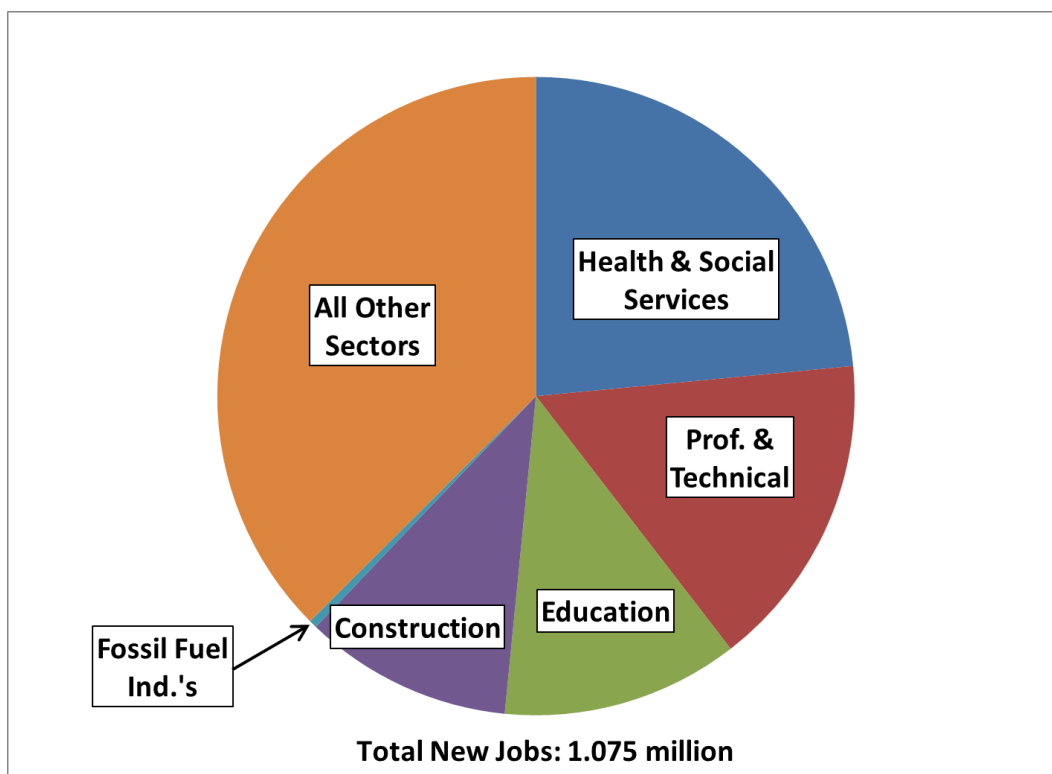
Remember, too, that the full phase-out of fossil fuels will occur over many years: two decades or more (to help reach net carbon neutrality by 2050). A 20-year phase-out of fossil fuels would imply an annual reduction in related employment of 6,650 jobs per year. That is barely large enough to even register in Australia's labour market statistics. (For comparison, during the last 5 years Australia's economy produced 6,650 new jobs every 9 days.) And as will be discussed below, so long as the phase-out occurs gradually over a well-announced and long-term timetable, most or all of those 6,650 job reductions can be accomplished through retirement, redeployment and other forms of voluntary severance.

It is interesting to compare the scale and trajectory of employment in fossil fuel industries, to the employment outlook in Australia's single largest industry: health care (the industry in which most HESTA members work). The broader health care and social services sector employs over 1.7 million Australians. That is over 13 times as large as the fossil fuel sector. Health care employment has grown in the last 5 years by 65,000 positions per year. It would thus take just 2 years of *new* work in health care alone, to fully offset *all* current jobs in fossil fuel industries. Health care and social services created more than 100 times as many new jobs over the past 5 years in Australia as fossil fuels. If we truly care about creating new jobs in the future, then it is large sectors like health care that should attract our top attention – because they will clearly generate the lion's share of new work.

Looking forward to coming years, even without the accelerating transition to alternative energy sources, it was already apparent that fossil fuel industries will become even less significant as a source of new jobs. There will be virtually no net hiring in these sectors, even without policies aimed at facilitating greater use of renewable energies. The federal government's own Department of Employment

develops five-year employment projections by industry; its current forecast sees virtually no change in employment in the fossil fuel industries listed above (see Figure 4): 4,000 new jobs expected over 5 years (in a status quo policy framework), representing just 0.4% of new work over that period. So even under existing policy settings, the share of fossil fuel industries in total employment will decline steadily.

Figure 4: Change in Employment by Industry, 5 Years to 2024



Source: Dept. of Employment Skills, Small and Family Business (2019).

In fact, since fossil fuel industries tend to be highly capital-intensive, they produce far fewer direct jobs for any given level of output than other sectors. As indicated in Table 2, on average only 1.2 jobs are created in fossil fuel industries for every \$1 million in value-added (or GDP) produced by the industry; most of the revenue generated in these industries is received not by workers in wages, but by the owners of the businesses (which are often foreign-based, reflecting the heavy foreign investment that is typical of fossil fuel industries). There is no other major sector in Australia's economy that generates fewer jobs per unit of output. In contrast, across the economy as a whole, an average of 7.2 jobs is generated for each \$1 million of value-added. In other words, the rest of the economy (on average) is six times more powerful at generating employment from a given amount of economic output. There is no doubt that if the goal is genuinely to create and sustain employment, fossil fuel production is one of the worst ways to go about it.

Table 2 Employment Intensity of Production by Sector, 2019			
	GDP (\$ Bil)	Employment (000)	Jobs per \$1 Million GDP
<i>Fossil Fuel Industries</i>			
Coal Mining	44.7	52.1	1.2
Oil & Gas Extraction	48.9	28.1	0.6
Pet'm & Coal Refining ¹	2.0	4.8	2.4
Electricity	12.8	33.2	2.6
Gas Supply	2.0	11.9	5.9
TOTAL FOSSIL FUEL	110.4	130.1	1.2
<i>Other Major Sectors</i>			
Mining	166.1	243.0	1.5
Manufacturing	104.5	884.6	8.5
Utilities	46.2	158.0	3.4
Construction	134.6	1171.4	8.7
Wholesale	71.3	394.2	5.5
Retail	78.2	1274.4	16.3
Hospitality	43.4	915.0	21.1
Transport	86.0	664.1	7.7
Info. & Comm.	46.2	208.8	4.5
Finance	165.7	447.9	2.7
Rental & Hiring	56.4	211.7	3.8
Prof. & Science	133.9	1145.3	8.6
Admin. & Support	65.7	453.8	6.9
Public Admin.	100.2	832.5	8.3
Education	90.6	1069.2	11.8
Health & Soc.Serv.	142.3	1723.5	12.1
Arts & Rec.	16.1	251.5	15.6
Other Services	34.6	514.6	14.9
TOTAL ECONOMY	1779.8	12893.1	7.2
Source: Author's calculations from ABS Catalogues 6291.0.55.003 and 5206.0.			
1. Petroleum and coal refining data for 2017-18.			

Of course, those direct employment numbers do not tell the whole story about an industry's economic importance. We are also concerned with the quality of work, not just the quantity. (We will discuss job quality issues in fossil fuel industries further below.) And there are other jobs in the economy that are indirectly related to fossil fuel industries: such as fuel retailing and auto mechanics. But we can be confident that those indirect jobs will be readily replaced as alternative energy sources are rolled out. For example, electric vehicles (which are already far cheaper to operate than

traditional internal combustion engines) also require maintenance and recharging facilities.

It is also true that some fossil fuel businesses serve as important ‘anchor’ industries in particular regional communities, thus underpinning other jobs in those regions. A major mine, for example, may indirectly support many other local jobs in industries like retail, services, and construction.⁷ But other ‘anchor’ industries can also play that same role in supporting a broader network of local jobs. For example, major facilities like hospitals, factories, TAFEs, tourism facilities, and head offices are as effective as any fossil fuel facility in generating local employment spin-offs (in retail, private services, construction, etc.). Indeed, because they create relatively few direct jobs (1.2 jobs per \$1 million in value-added, compared to 7.2 jobs in the economy as a whole), fossil fuel industries generate weaker local employment spin-offs than other regional employment anchors. So as the economy transitions from fossil fuel production to other forms of industry, spin-off employment effects from those anchor industries will get stronger, not weaker.

In sum, the statistical evidence tells a clear story: While fossil fuel industries are an important source of work in some particular regions of Australia (and are obviously important to those who work there today), they are not a large employer in the context of Australia’s overall economy. A managed transition away from that work – planned, supported, and phased-in over many years – can certainly be accomplished successfully, with minimum dislocation.

⁷ Many new mines in Australia, however, are developed on a Fly-In-Fly-Out (FIFO) basis, with no effort to develop a local community near the mine. This largely eliminates the spin-off local job creation from those projects.

The Regional Distribution of Fossil Fuel Employment

In the aggregate Australian economy, fossil fuel industries are not a major employer. They directly account for only 1% of all jobs, and it takes an extra \$1.2 million of fossil fuel value-added to produce just one additional job. For the labour market as a whole, growth in other industries (which have much stronger employment spin-offs) will dwarf the impact of any changes in fossil fuel industries – even their ultimate phase-out.

However, fossil fuel jobs are not evenly distributed across the country. In a few regions of Australia, fossil fuel jobs are more concentrated. Hence those regions will feel the impact of the phase-out of fossil fuels more noticeably. This complicates the process of planning for employment transitions.

In actuality, the number of regional communities in Australia that depend heavily on fossil fuel jobs is surprisingly small. We analyse the regional distribution of fossil fuel employment on the basis of data from Australia's most recent census (conducted in 2016). It provides detailed employment data for 350 different local communities at the SA3 level of disaggregation.⁸ Of those 350 communities, there were only 11 where fossil fuel industries combined accounted for over 5% of total employment. Of those 11 SA3 areas, 6 are in Queensland (including Central, Biloela, Rockhampton, Bower Basin, Mackay, and Whitsunday), 4 are in NSW (Lithgow, Lower and Upper Hunter, and Maitland), and one is in Western Australia (West Pilbara). About one-quarter of all fossil fuel jobs in Australia are concentrated in those 11 communities.

Moreover, because those 11 communities are relatively small and sparsely populated, they account for an even smaller share of Australia's total population; just 2.5% of Australians lived in those 11 fossil fuel-dependent communities in 2016. This is not to imply that this small group of regional communities is not important. Rather, the data simply confirm that the scale of the challenge required to support transitions in fossil fuel-dependent communities is manageable, since few Australians are affected.

Even within those 11 particularly fossil fuel-dependent communities, fossil fuel industries accounted for a minority of total employment in 2016. On average across those 11 communities, around 1 in 9 jobs in total, or 11% of employment, was in fossil

⁸ Excluding respondents living in migratory, offshore and shipping regions when the census was conducted.

fuel industries. Almost as many jobs existed in health care and social services in those 11 communities, as existed in fossil fuel industries. In other words, it would be just as accurate to describe those 11 communities as ‘health care-dependent’ regions, as to call them fossil fuel-dependent! This dramatises the leading importance of other major sectors (like health care) in determining overall employment trends throughout Australia – even in regions which display a unique concentration of fossil fuel-related employment.

Table 3 Regional Distribution of Fossil Fuel Employment, 2016 Census					
	#	Fossil Fuel Industries		Health Care & Social Services	
		Jobs (000)	% Total Emp.	Jobs (000)	% Total Emp.
All SA3's	350	119.0	1.0%	1544.3	12.9%
Fossil-fuel Dependent SA3's	11	29.6	11.4%	27.4	10.6%
All Regional Australia ¹		58.6	1.8%	445.1	13.9%
Source: Author's calculations from ABS Census TableBuilder.					
1. Outside of the 8 greater capital city regions.					

Elsewhere in Australia, including in the vast majority of regional towns, fossil fuel industries are not a major employer. For example, on average across all of regional Australia (outside of the 8 greater capital city regions), fossil fuel industries account for just 1.8% of total employment. Health care and social services employment is 7.5 times larger in regional Australia than fossil fuel employment. (In Australia as a whole, the corresponding ratio is 13-to-1.)

And in fully 342 of the 350 communities profiled in the SA3 data (*including* 3 of the 11 fossil fuel-dependent communities listed above), health care and social services employed more people than combined fossil fuel industries.

It is certainly true, therefore, that some communities in Australia will experience the employment effects of the transition away from fossil fuels more noticeably. But the number of communities that depend heavily on fossil fuel employment is small. With appropriately targeted support measures and alternative job-creation initiatives (discussed further below), those regionally concentrated impacts can be addressed, and local workers and residents protected.

And in general, even regional Australia is not at all dependent on fossil fuel employment. It will be the trend of employment in other sectors that shapes the overall health of Australia's labour market, and that will determine employment

opportunities everywhere in Australia – even in those relatively few communities where fossil fuel jobs are genuinely significant.

Perhaps surprisingly, about half of all jobs in the fossil fuel industries are located in the greater capital city areas. This includes a range of occupations and functions, including head office jobs, technical and professional roles, manufacturing and distribution jobs. For fossil fuel workers in urban areas, opportunities for transitioning to alternative employment are more obvious, given the size and economic diversity of the places they live.

In short, if we want to strengthen employment opportunities anywhere in Australia, we must engage the most powerful drivers of job-creation: public services, private services, construction, manufacturing and agriculture. Those are the industries that will shape the future of work in Australia – even in the small number of communities which depend heavily on fossil fuel jobs today.

Past Employment Transitions in Australian History

Australians are no strangers to economic change. Our national economy and labour force have experienced dramatic structural shifts in the past. And we will experience more of them in the future. Indeed, 'change' has been a constant feature of Australia's economic history.

Moreover, several of the economic and employment transitions successfully traversed by Australians in the past were larger, in relative terms, than the coming transition away from fossil fuel production and use. Some of those structural shifts were negative, featuring major reductions in employment in certain sectors or regions. Some were more positive: powered by the gravitational pull of new jobs, new technologies, and new occupations. Change is easiest, in fact, when those two dimensions coincide: that is, when people displaced from one vocation have abundant alternative opportunities to pursue, and when rapidly growing industries have access to new sources of labour and talent freed up by the contraction of other, older occupations.

When those past tectonic changes occurred, they were inevitably accompanied by uncertainty, fear, and in some cases hardship. But in the end, Australia's labour market, and the individuals who comprise it, adjusted – in most cases surprisingly quickly. Entire industries disappeared, and new ones were born. Populations shifted from one place to another. New skills were learned, new investments made, new technologies perfected. And in the end, Australians were better off: with higher productivity, higher incomes, more interesting jobs, and more rewarding, healthier lives. Our collective capacity to adapt and change is still with us today; we can have confidence in our continuing ability to manage change effectively and fairly.

Here are just some of the previous large economic transitions Australia has experienced. Relative to the relevant population base at the time, all of these transitions were at least as large as (and in most cases larger than) the coming transition away from fossil fuels. They were all experienced without lasting increases in unemployment or a decline in living standards. This experience shows that – paired with smart policies and strong supports for affected workers and communities – the coming phase-out of fossil fuel industries is fully manageable.

Agriculture: At the time of Federation, some 25% of employed Australians worked in the agricultural industry.⁹ Today that has declined to just 2%. As a share of the workforce, the decline in agricultural employment was more than 20 times bigger than the coming transition away from fossil fuel jobs. The long-run shift of work away from farms was an inevitable dimension of Australia's evolution into a modern industrial economy. To be sure, that involved painful decisions by many people, especially young people, to leave the rural communities where they were born and raised. They were ultimately motivated by their judgment that their lives would be improved by doing so.

Urbanisation: The flip side of the coin of agricultural depopulation has been the explosive growth of population and employment in Australia's major cities. At the time of Federation, about one-third of Australians lived in the greater capital cities.¹⁰ That share has doubled to two-thirds today.¹¹ The increasing concentration of new jobs in the major cities poses problems and challenges, including stressed infrastructure and high housing costs. But large cities have become the most important engines of Australia's economy. They offer substantially higher incomes and a broader range of opportunities. Ongoing urbanisation continues to boost Australian growth, productivity and incomes. Half of fossil fuel jobs in Australia are located in urban regions, which offer a wide range of alternative employment prospects; transitions away from those jobs, therefore, will be relatively easier to manage.

Women's Paid Work: Another enormous shift in Australia's labour market has been the dramatic increase in women's participation in paid work. In 1964, women constituted just 28% of the paid labour force. (Of course, women always performed a disproportionate share of unpaid work in homes and communities.) Today women constitute almost half the paid workforce: 47% in 2019.¹² Adjusting to women's increased labour supply has required many changes: in families, in workplaces, in government policies. But initial fears that there wouldn't be enough work to employ those women were completely unfounded. Today, in fact, women typically experience slightly lower unemployment than men. The labour market adapted to women's growing participation, and Australians are better off for it.

Automotive: Australia once ranked in the top ten automotive producers in the world. Today, no mass vehicle assembly operations exist here anymore – following the shutdown of the industry's last remaining plants in 2016. At the turn of the century, the motor vehicle and parts manufacturing sector employed around 80,000

⁹ Hatton and Withers (2014).

¹⁰ Frost (2014).

¹¹ Calculations from ABS Catalogue 3218.0.

¹² Calculations from ABS Catalogue 6202.0, Table 1.

Australians. Most of those jobs have now disappeared. However, despite the pain of this downsizing, the communities most affected by the shut-down have adapted remarkably. Auto production was more regionally concentrated than fossil fuel industries: most auto jobs were located in just two regions, in Victoria and South Australia. This regionally concentrated shock caused substantial dislocation to many families and communities; the respective state governments undertook significant efforts to support adjustment and job-search for affected workers, but the federal government was relatively absent from that effort. Since the initial shutdowns, both of those regional labour markets have experienced a significant rebound in employment, spread across a diverse range of occupations.¹³ Recent initiatives in the field of electric vehicles manufacturing are contributing to the recovery in those regions.

Scientific & Technical: Measured by total employment, the fastest-growing sector in Australia has been the professional, scientific and technical services industry. Total employment grew 24% over just the past 5 years – adding 225,000 new positions, and vaulting the sector past education to become Australia’s fourth largest employer. This industry is skills-intensive, highly productive, and generates above-average earnings. Of course, rapid change may seem ‘easier’ when it involves expansion and new opportunity. But rapid growth can be stressful, too. And the economic reality is that strong growth in vibrant sectors requires a relative contraction in others, in order to free up needed resources. The continuing growth of Australia’s high-tech industry will require a steady supply of available workers, and these new jobs will be an important source of strength in the future labour market.

Textile, Clothing & Footwear: Another major industrial adjustment process involved Australia’s textile, clothing and footwear manufacturers. In 1987 the industry employed 125,000 Australians – accounting at that time for 1.8% of national employment (almost twice as large a share of jobs as fossil fuel industries account for today). Changes in national trade and industrial policy led to the unfettered import of cheaper foreign-made products, which wiped out large sections of the domestic industry. Targeted adjustment programs were established to support the resulting job transitions. Today the sector employs less than 30,000 people in Australia, focused primarily in specialised and smaller-volume niche product lines. There were both costs and benefits associated with this policy choice, and the change was painful for many. But few would argue that the industry should have been preserved in its 1980s state.

In summary, the coming transition away from fossil fuel industries, which will be accomplished over an extended period of time (not through a sudden shut-down), is

¹³ ACIL Allen Consulting (2019).

not at all unprecedented. Australia's labour market has shown a consistent ability to respond to major changes like this one, adapting and finding new sources of work and productivity. Supported by appropriate transitional policies and supports, we can be confident in the labour markets ability to adapt to similar changes in the future.

A Labour Market in Constant Motion

The long history of dramatic change in Australian employment patterns – both positive and negative – confirms that ongoing structural change is an inherent feature of the labour market. Employment is constantly shifting across industries, occupations, regions, and demographic groups. Because it aggregates the decisions of millions of individual workers and employers, each following their own best judgments regarding personal, industrial, macroeconomic, and policy conditions, the labour market has an innate and impressive capacity to adjust over time. That flexibility will be crucial in facilitating the relatively modest employment adjustments associated with the coming transition away from fossil fuels.

To give some perspective on the different forces driving labour market adjustment, consider the various flows and adjustments that occur in national employment in just a single month. Media coverage about national job-creation statistics usually reports the *net* change in *total* employment from one month to the next. That number is usually positive: typically between 15,000 and 60,000 net new jobs each month, representing a small expansion in the total amount of work being performed (with a typical growth rate of around 0.2% per month).

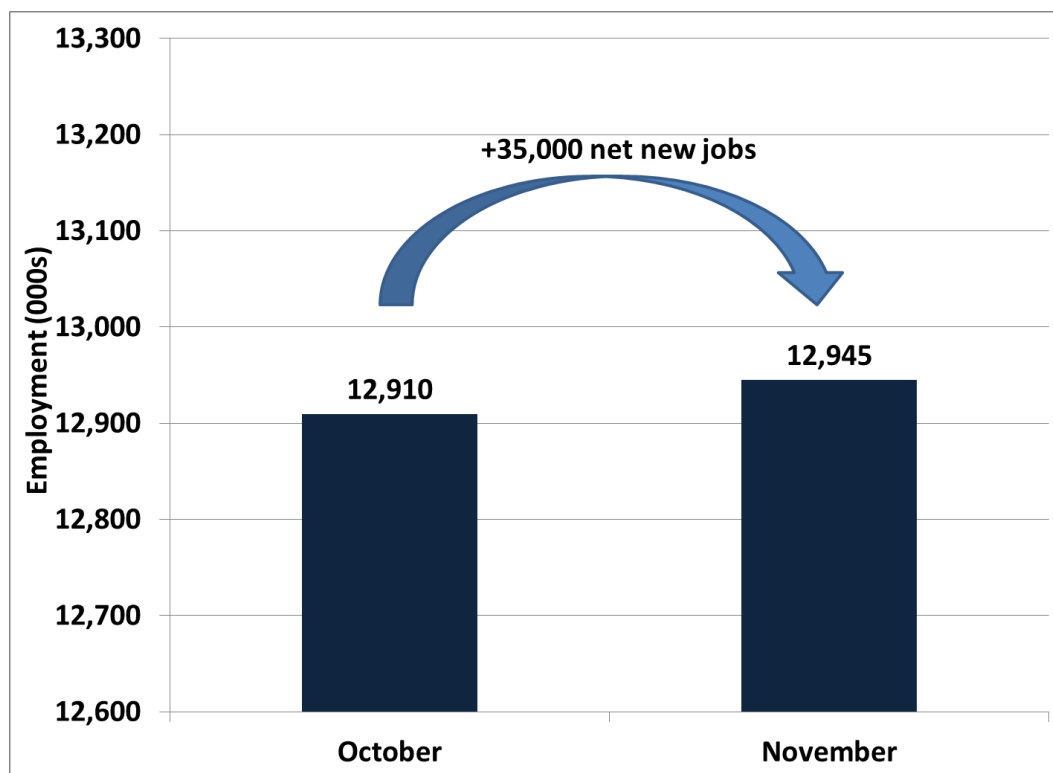
But underneath that rather undramatic gradual growth – think of it as the relatively calm ‘surface’ of the labour market – there is a constant whirlpool of labour market churn. The headline number reports net job creation across the whole economy: it equals the total jobs created, less any jobs that disappeared. But on a ‘gross’ basis, far more jobs are created each month than is implied by that monthly net total. However, most of those new jobs are offset by a substantial number of other jobs that disappear each month.

Similarly, the number of individual Australians who find new work in a given month is much larger than the net number of new jobs created. That’s because the large number of people finding new work, is offset by another large group of Australians who *lost* work in that same month. There are many reasons why Australians lose work: some become unemployed, but most choose voluntarily to leave their jobs (for study, family reasons, or retirement).

All of those significant, constant adjustments in the labour market add up to a relatively small monthly change in total net employment. That net figure dramatically

understates the true amount of flux that regularly occurs. So we shouldn't be misled by the apparent 'calm' on the surface of the labour market, to overlook the incredible dynamism unfolding underneath.

Figure 5: Net Employment Creation, November 2019

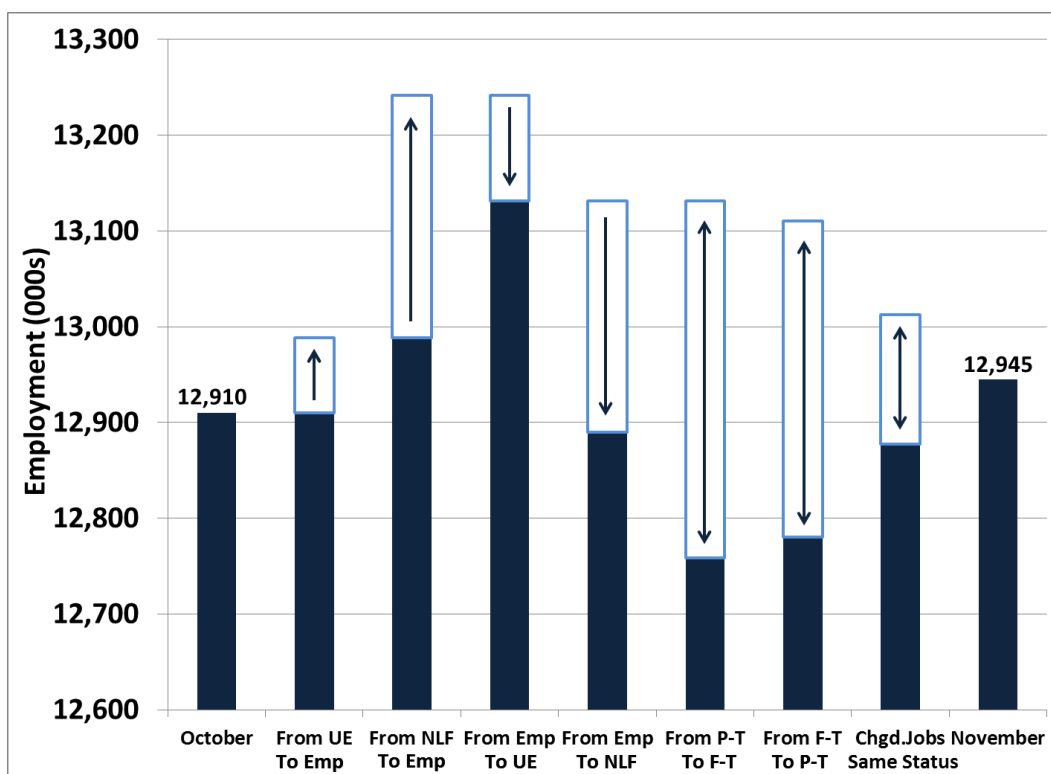


Source: Author's calculations from ABS Catalogue 6202.0, Data Cube GM1.

Figures 5 and 6 portray those stark differences between net and gross changes in employment. The two figures provide two different illustrations of the change in employment in one typical recent month: November, 2019. As indicated in Figure 5, total employment increased that month by 35,000 positions. That was a relatively good monthly result. But it was a small, gradual change: equivalent to an increase of about one-quarter of one percent in the total number of people working.

However, that seemingly placid overall result hid enormous change and turmoil that occurred in different parts of the labour market that month. The small positive expansion in net employment was the bottom-line balance of many complicated, larger changes in underlying employment patterns: some positive, but many negative. In imagining how the labour market could adjust to a significant change – like the phase-out of fossil fuel production – it's very important to understand the intense flux that it experiences all the time. That will enhance our confidence in the capacity of the labour market to absorb and adapt to other changes (like phasing out fossil fuels).

Figure 6: Gross and Net Flows of Labour, November 2019



Source: Author's calculations as described in text, from ABS Catalogue 6202.0, Data Cube GM1.

In contrast, Figure 6 illustrates just some of the bigger 'gross' changes that occurred in the labour market in November 2019 – but which are invisible in a simple comparison of net employment totals. A total of 332,000 Australians started working that month. That's almost ten times as many as implied by the smaller net increase in employment. Only about one-quarter of those newly-employed people had been officially 'unemployed' in October. Instead, most of them (three-quarters) moved directly from being 'not in the labour force' straight into employment. That means that while they had not been working in October, they had not been actively seeking work (or available for work) either – and hence were not counted as 'unemployed.' They officially 'joined' the labour force only when they started their new jobs.

Why don't newspaper headlines trumpet that 332,000 jobs were *created* in November? Well, because about as many other jobs *disappeared* in the same month. Hence the net change in overall employment was much smaller.

Many other employment transitions also occurred behind the scenes of the labour market in November. For example, around 330,000 Australians transitioned from full-time jobs to part-time jobs. A slightly larger number transitioned from part-time jobs

to full-time jobs. As a result, the overall proportion of workers in full-time positions increased slightly that month. Many more workers moved from one job to another, but without changing from part-time to full-time (or vice versa). Those job-to-job flows are not directly recorded in the ABS's monthly gross labour market data; on the basis of annual statistics, however, we estimate that at least 135,000 Australians per month experience that sort of employment change.¹⁴

As illustrated in Figure 6, therefore, there is an enormous amount of 'to and fro' within the labour market every month. Almost always, it nets out to small incremental changes in total employment. But in total, over 10% of the adult population experiences some change in their employment status in any given month: into or out of employment, from one job to another, or between part-time and full-time hours. Because of this enormous ongoing adjustment and evolution, the labour market possesses enormous flexibility to respond to even seemingly large shifts in the structure or location of employment. Adjustments in those normal monthly flows can facilitate big changes in the overall structure of employment without causing 'drama' at the macroeconomic level.

The cumulating impact of these gradual month-to-month transitions is confirmed by ABS data on the frequency of job turnover over the course of a typical year. As of February 2019,¹⁵ almost 20% of Australian employed people had been with their current employer or business for less than 12 months. In other words, 1 in 5 workers started their current position within the past year. Some of those newly-hired workers were new entrants to the labour force, but many of them (1.1 million) moved from a previous job.

Similarly, of the 12.5 million Australians who were employed as of February 2018, just under 2 million left their jobs in the following 12 months.¹⁶ About two-thirds did so voluntarily: leaving for another job, to retire, or to pursue other interests or responsibilities (such as family care or higher education). About one-third of job-leavers did so involuntarily (being retrenched, or reaching the end of a time-limited contract). Almost 16% of employed Australians, therefore, left their previous jobs in that year.

The sheer number of workers who change jobs in the course of just one year of labour market adjustment is impressive. So, too, are the numerous different dimensions of

¹⁴ This estimate is derived from data on the total number of Australians changing employers in a year (ABS Catalogue 6226.0, Table 18), and an assumed frequency of job change for those changing of 1.5.

¹⁵ The ABS's annual survey of labour mobility is conducted in February each year. See ABS Catalogue 6226.0, Table 18.

¹⁶ From ABS catalogue 6226.0, Table 17.

change which workers demonstrate in that process. These dimensions are listed in Table 4. Of the 1.1 million workers who changed employers in the year ending February 2019, over 600,000 changed industries, and over 450,000 changed their occupation. Some 745,000 workers changed their hours of work as part of their new job. 365,000 changed their status of employment (between permanent and casual, or between waged work and self-employment).

Table 4 Change is Constant: Employment Transitions in One Year (12 months to February 2019)		
	Number (000)	Share of Total Employment
Working for a New Employer	2,429.9	19.1%
Started Working in This Job	1,351.7	10.6%
Changed from a Previous Job	1,078.3	8.5%
<i>Of Those Who Changed Jobs:</i>		
Also Changed Industry	604.5	4.7%
Also Changed Occupation	468.4	3.7%
Also Changed Usual Hours	745.3	5.8%
Also Changed Status	365.9	2.9%
<i>Working for Same Employer:</i>	8,147.1	63.9%
Changed Occupation	201.7	1.6%
Changed Usual Hours	833.5	6.5%
Promoted	934.6	7.3%
Transferred	822.8	6.5%
Source: Author's calculations from ABS Catalogue 6226.0.		

Far-reaching flexibility is also apparent even among those workers who stayed with the same employer or business during the previous year, as also summarised in Table 4. Over 200,000 workers changed occupations, without changing their employer. Over 800,000 changed their hours of work, and 1.3 million workers were promoted, transferred, or both.¹⁷

Another dimension of the flexibility of the Australian labour market is the growing number of Australians who work in more than one job. As of February 2019, 2.26 million Australians (or 18% of all employed people) held more than one job.¹⁸ Multiple job-holding is a sign of the growing insecurity of many jobs in Australia; but it also

¹⁷ Table 4 indicates that 935,000 workers were promoted, and 823,000 were transferred; since some workers were both promoted and transferred, the total experiencing one or more of those changes (1.3 million) is smaller than the total of those two figures.

¹⁸ Calculations from ABS Catalogue 6226.0, Table 17.

represents an additional source of flexibility. These workers are already familiar with the reality of adjusting their work across multiple employment relationships, as the demand for their services evolves across employers. They are thus particularly attuned to the inevitability of labour market change.

In sum, around one-third of the entire employed Australian workforce experience some fundamental change in the nature of their work in just a single year: starting work with a new employer, switching jobs, or changing the occupation, hours, or status of their work with an existing employer. Clearly, Australia's labour market experiences a constant and intense 'hum' of change all the time – even when aggregate employment levels are stable. That inherent, underlying flexibility is what allows labour markets to adapt so effectively to major changes in the structure or location of employment. That was confirmed by the preceding review of previous historic employment transitions in Australia's past.

All of these avenues of flexibility will be necessary and valuable, as Australia's labour market adjusts to the coming reduction in work associated with fossil fuel industries. As we have noted, the scale of that adjustment is not large, relative to the overall size of the labour market, or to other historic shifts in Australia's employment patterns. By enlisting the normal, ongoing processes of labour market adjustment, and giving ample time for those adjustments to occur, the employment transition away from fossil fuels can certainly be accomplished without dramatic shock or displacement.

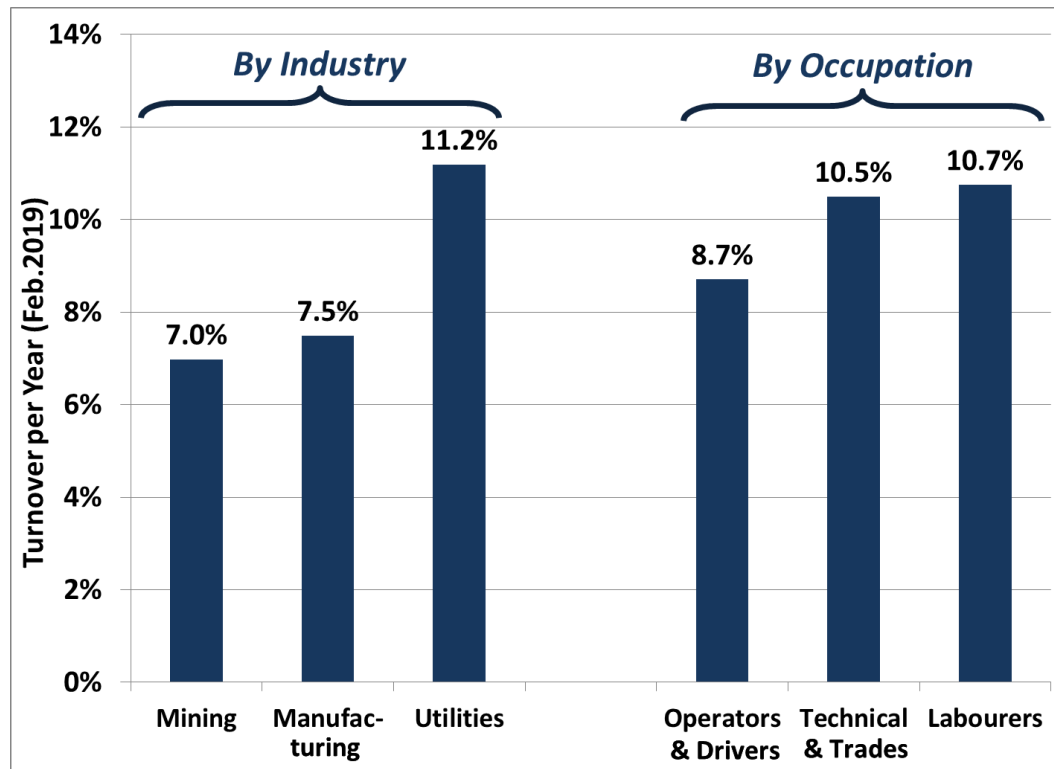
Aggregate annual turnover rates for the broad industrial sectors and occupational categories corresponding to fossil fuel jobs are depicted in Figure 7.¹⁹ Recall, from above, that we identified five specific sub-sectors of direct fossil fuel employment, which are spread across three broad economic sectors: mining, manufacturing, and utilities. Annual turnover in mining and manufacturing workplaces averages above 7%. In some challenging mining jobs, turnover is much higher; for example, annual turnover in fly-in fly-out mining operations has been measured at 20% per year, because of the intense personal and family stresses resulting from that system.²⁰ In utilities (including electricity and gas supply), annual turnover is above 11%. Many specific occupations common in fossil fuel work also experience elevated levels of

¹⁹ Annual turnover is proxied here by the proportion of employment in each industry or occupation that has been with their current employer or business for less than 12 months. That will be exactly identical to the proportion of existing employees that leave their job in a year, in industries which experience stable overall employment (as has been the case for most fossil fuel industries, as described above). For industries with shrinking total employment (such as coal and petroleum refining and utilities), this measure of turnover underestimates the true rate of job departures.

²⁰ For example, see Beach, Brereton and Cliff (2003), who found annual turnover of 21% across 7 FIFO mining operations.

turnover, including annual turnover rates above 10% for technical workers, tradespeople, and labourers.

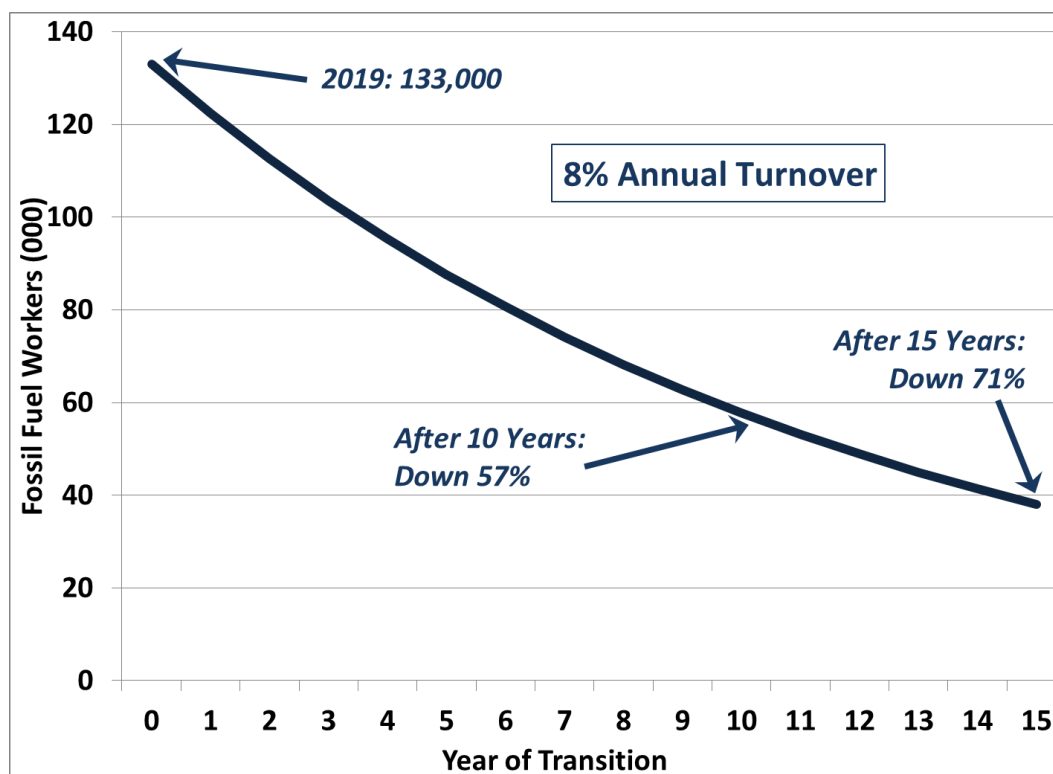
Figure 7: Annual Turnover by Industry and Occupation, 2019



Source: Author's calculations from ABS Catalogue 6226.0.

Such significant ongoing turnover in employment has a dramatic cumulative impact on the composition of the workforce in any industry, and drives powerful employment transitions over time. We assume, conservatively, that fossil fuel jobs in general experience annual turnover of about 8%. (Based on the mix of industry- and occupation-specific turnover rates illustrated in Figure 6, average turnover for all fossil fuel jobs is likely higher than 8%.) An initial population of 100 employees in the industry, therefore, will dissipate quite rapidly over time, based solely on normal, mostly voluntary departures from their previous positions. Figure 8 illustrates the steady, powerful impact of that normal, ongoing employee turnover. At an 8% turnover rate, over half of the initial workforce has left after 10 years, and over 70% have left over 15 years.

Figure 8: Dissipation of Fossil Fuel Jobs Through Normal Exit



Source: Author's calculations as described in text.

Facilitating a downsizing in employment while protecting people currently working in the sector can therefore be largely accomplished by taking advantage of this natural turnover. An industry doesn't have to be shut down in one powerful act; it can be phased out of existence more gradually, as workers voluntarily leave for other opportunities. The crucial complement to that strategy, however, must also be to *limit inward flows* to the sector at the same time. If the natural flow of departing workers were replaced by new hires, then the adjustment problem is simply recreated and deferred. It seems especially counter-productive to invite new entrants to start building careers in an industry with such an inherently time-limited horizon.

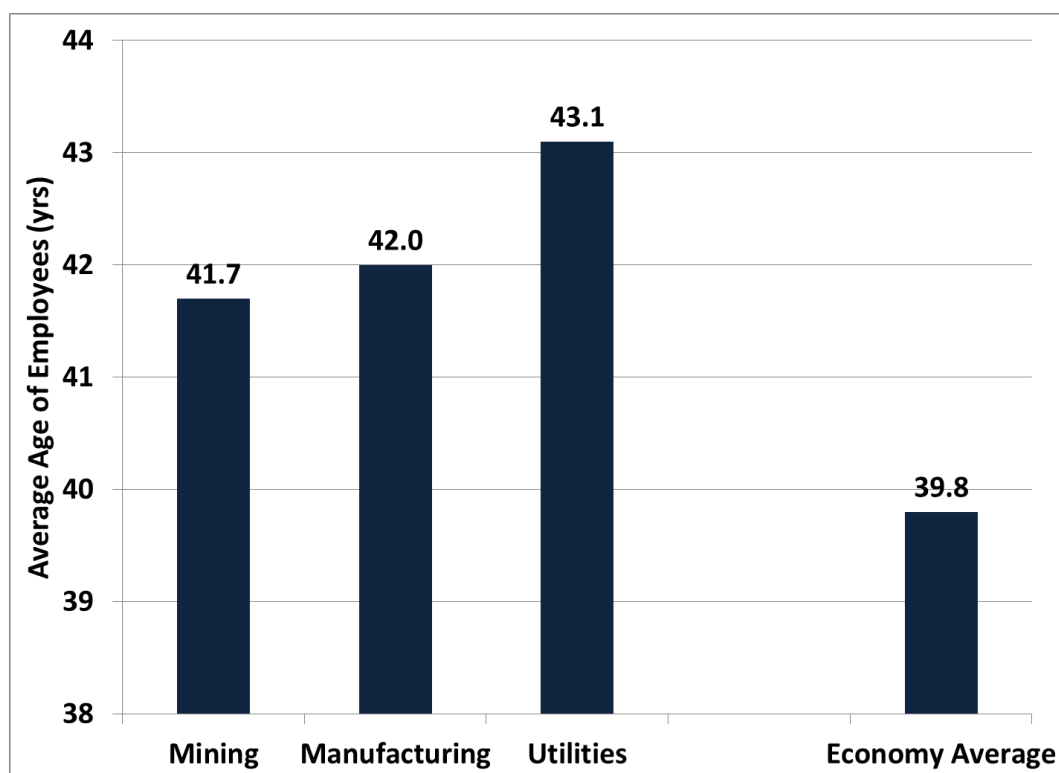
To take full advantage of the natural forces of ageing and turnover, therefore, a clear timetable for phasing out fossil fuels must be established as far in advance as possible. If the commitment to phasing out fossil fuels is diluted or delayed (typically because of shorter-run political and ideological considerations), then the resulting employment transitions become needlessly more difficult – because in the meantime, many more individuals have started work, in an industry that will soon disappear. In contrast, committing well in advance to a fossil fuel phase-out will accelerate the pace of departures from the existing workforce, since many workers will then watch for and take advantage of alternative opportunities that arise during the transition. That

anticipatory turnover can be supported with generous severance, retraining and relocation incentives (as discussed further below).

Another related dimension of these natural, ongoing labour market transitions is the inevitable fact that workers get old and eventually retire. And workers currently employed in fossil fuel industries tend to be significantly older than the overall Australian workforce. So the normal outflow of retiring workers will be especially important in the phase-out of fossil fuel work.

As indicated in Figure 9, workers in fossil fuel industries are significantly older than the average for the workforce as a whole. This data is available for the three broad economic sectors (mining, manufacturing, and utilities) which encompass fossil fuel employment. Current mining and manufacturing workers, on average, are around 42 years of age; utility workers, on average, are over 43 years old (making it one of the oldest sectors in the whole economy). In contrast, the average age of the overall national workforce is under 40 years.²¹

Figure 9. Average Age of Employees by Broad Sector, 2018



Source: ABS Catalogue 6306.0.

²¹ Data on average age is not available at the sub-sectoral level (eg. for petroleum and coal refining), but only at the sectoral level (eg. for all manufacturing).

The older demographic profile of the fossil fuel workforce reflects the fact that employment in these industries has been relatively stagnant in recent years. In contrast, other industries were expanding total employment, recruiting more new labour force entrants – and hence they possess a relatively younger workforce.

The relatively advanced age of the fossil fuel workforce constitutes an important advantage in planning for the necessary economic transition away from fossil fuel production and use. A larger-than-proportional share of these workers will be retiring from their careers anyway over the next two decades. That will ease the process of overall downsizing, since a substantial proportion of existing workers can plan to retire normally from the industry as it gradually phases down.

Other Threats to Fossil Fuel Jobs

The coming phase-out of fossil fuel production and use poses a significant but manageable challenge to the employment and income security of workers currently employed in those industries. The total number of people working in those activities is relatively small, in the context of Australia's overall labour market: only 1% of all jobs. And normal processes of adjustment and attrition will be sufficient to facilitate most of the needed adjustment: so long as the phase-out of fossil fuels is announced well in advance, and departing workers are not replaced.

It is also important to remember that status quo economic arrangements are hardly conducive to a secure and stable employment outlook for fossil fuel workers, even in the absence of policies to facilitate the transition to renewable energy sources. In other words, simply rejecting climate policies cannot guarantee the existing jobs and incomes of people currently employed in fossil fuel work. Fossil fuel workers face a range of daunting threats and challenges to their jobs, incomes, and working conditions. And the quality of fossil fuel jobs has been undermined in recent years by the aggressive practices of fossil fuel companies – striving to extract as much profit from production of the resource as possible, while the industry still exists.

Here are several of the major factors threatening both the quantity and quality of work in fossil fuel industries:

Global Market Fluctuations: Natural resource industries are notoriously volatile, subject to rapid changes in global prices, consumer demand, and trade patterns. While fossil fuel sectors in Australia have benefited at times from strong global demand and high prices, at other times prices are depressed, markets are stagnant, and job losses result. For example, in the current global market turmoil associated with the COVID-19 pandemic (and resulting world recession), demand for most fossil fuels has dipped significantly, putting downward pressure on employment in many Australian facilities. For example, several hundred redundancies were announced in Queensland's export-oriented coal mining sector in 2020 due to weak prices and demand conditions.²² The global mining giant Glencore has recently announced closure of four coal mines in Australia by 2023 (three in NSW and one in Queensland), also in response to deteriorating global coal market conditions.²³

²² See coverage in McGhee (2020).

²³ See Clarke (2020).

Automation: Fossil fuel companies are moving quickly to implement labour-saving systems and technologies in their mining, processing, and transportation operations. This push has been reinforced by the longer-run decline in global prices for most fossil fuel commodities since 2014, which squeezed profit margins and spurred automation. Several major mines and transport systems have been near-fully automated with autonomous drilling and blasting equipment, exaction systems, trucks and trains, and loading equipment.²⁴ McKinsey and Co. (2019) estimate this will ultimately reduce labour demand in key mining operations by 30%. One consequence of automation is the relocation of some fossil fuels jobs (involving operation of remote systems) to urban areas, instead of being located directly at remote mine sites. As noted above, this will make it easier for workers to identify alternative employment opportunities (using their high-tech skills) as fossil fuel production winds down, since many alternative employment opportunities exist in those cities.

Labour Hire and Outsourcing: Another dimension of cost-cutting efforts by fossil fuel companies in recent years has been a ruthless expansion of low-cost employment strategies – using labour hire firms, outsourced contractors, casual and temporary workers, temporary foreign visa workers, and other strategies to undermine job security and incomes for fossil fuel workers. These practices have become rife in the coal mining industry, among others, as large companies strive to cut costs and risks associated with traditional employment models (where in the past most workers were hired as direct employees). Major companies like BHP now employ more contractors than employees.²⁵

In some cases companies establish wholly-owned subsidiary labour-hire firms to act as ‘shell’ employers. Those subsidiaries nominally employ the workers (rather than the mining company), at lower wages. The workers are dispatched to perform equivalent work as traditional employees would have done. By thus reducing wages, entitlements, and work rules, these practices can reduce total compensation costs by one-third or more.²⁶ Employers also manipulate industrial relations loopholes to apply contractor-style compensation arrangements (often ‘approved’ in advance by a small number of non-union workers) to much larger groups of workers.²⁷ Through these techniques to cut labour costs, what might have once been considered superior compensation in mining and other fossil fuel industries has been diminished and

²⁴ See Toscana (2019) for several examples.

²⁵ See Smyth and Hume (2020); 60% of BHP’s global workforce now consists of contractors.

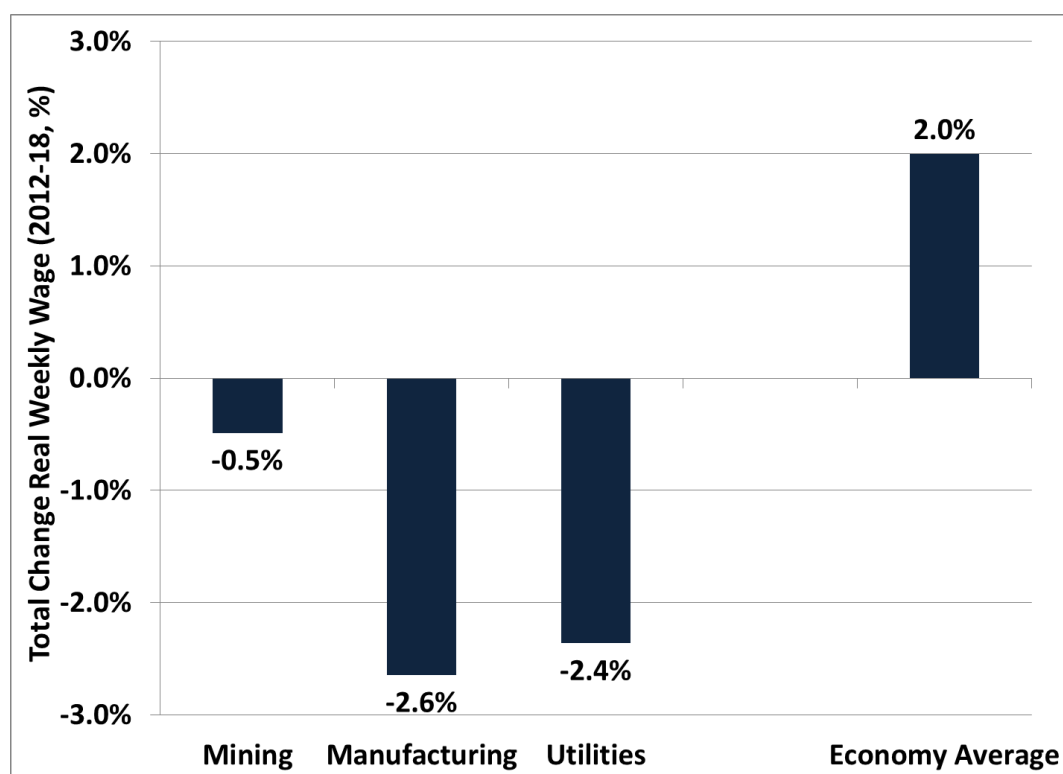
²⁶ See Kirkwood (2019) and Whelan (2020) for examples of these savings.

²⁷ See Workplace Express (2019) for just one of many examples.

devalued. One study estimates that outsourcing practices have reduced wages paid in the coal mining sector alone by \$1 billion per year.²⁸

Falling Wages: Because of generally weak hiring conditions, fluctuations in global commodity prices, and aggressive efforts to slash labour costs, real wages in fossil fuel jobs have been declining noticeably. Average weekly wages in fossil fuel industries tend to be higher than in many other occupations. To a large extent, those higher wages reflect long hours and difficult conditions (such as fly-in fly-out arrangements). More recently, however, real wages have fallen significantly.

Figure 10: Real Wage Growth by Industry



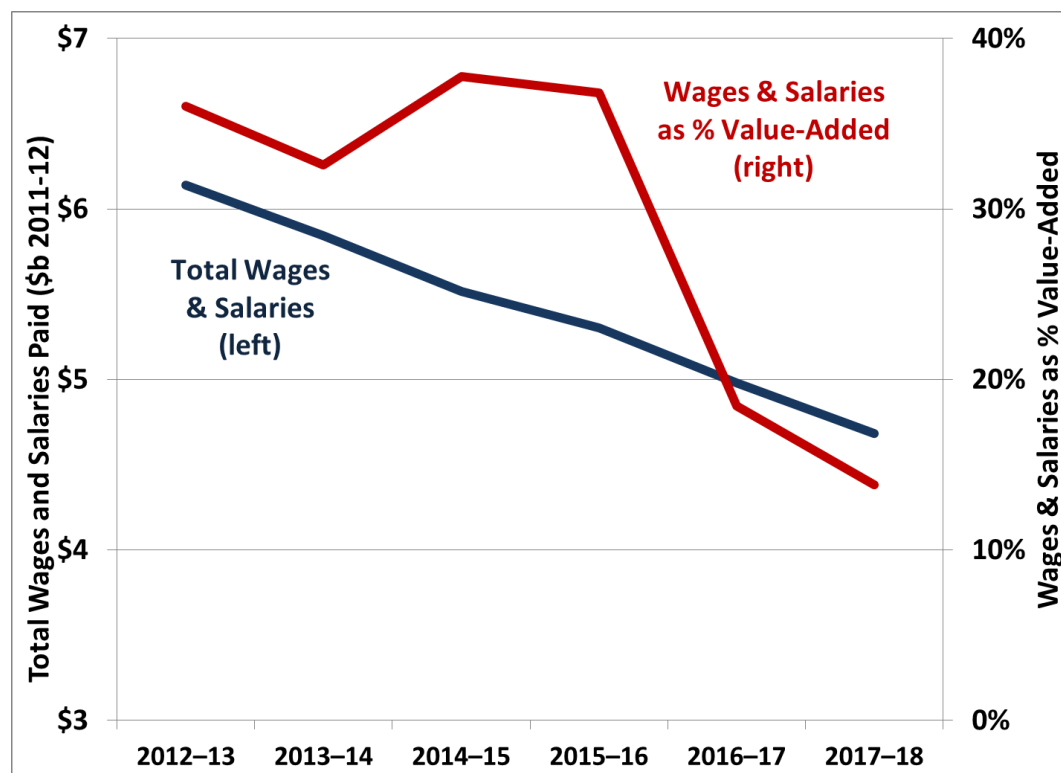
Source: Author's calculations from ABS Catalogues 6302.0 and 6401.0.

Figure 10 illustrates real wage trends in the three broad sectors of the economy that incorporate most direct fossil fuel jobs: mining, manufacturing and utilities. Since 2012, wages in all those sectors lagged behind inflation in Australia (even though inflation has been unusually slow). Hence the real purchasing power of fossil fuel wages has declined. That contrasts to modest, but positive, increases in average real wages experienced across the broader labour market.

²⁸ See Whelan (2020), p.7.

The dramatic impact on wages of concerted employer cost-cutting is especially visible in Australia's coal mining sector, where wages have been suppressed by automation, labour hire, outsourcing, and other strategies. As indicated in Figure 11, the total value of wages paid out in coal mining (adjusted for inflation) has fallen by one-quarter since 2012-13, down by about \$1.5 billion per year. This decline in wage and salary payments has occurred despite increases in total output and revenue for the industry. As a result, the share of total industry value-added paid out to Australian workers has fallen dramatically: to less than 14% by 2017-18, barely half the share of just five years earlier. Even in good times, production and profits in fossil fuel industries never fully translated into strong incomes for Australian workers, given the capital-intensive and largely foreign-owned nature of the industry. But that always-weak relationship has been broken in recent years, as a result of aggressive employer cost-cutting.

Figure 11: Declining Wages in Coal Mining

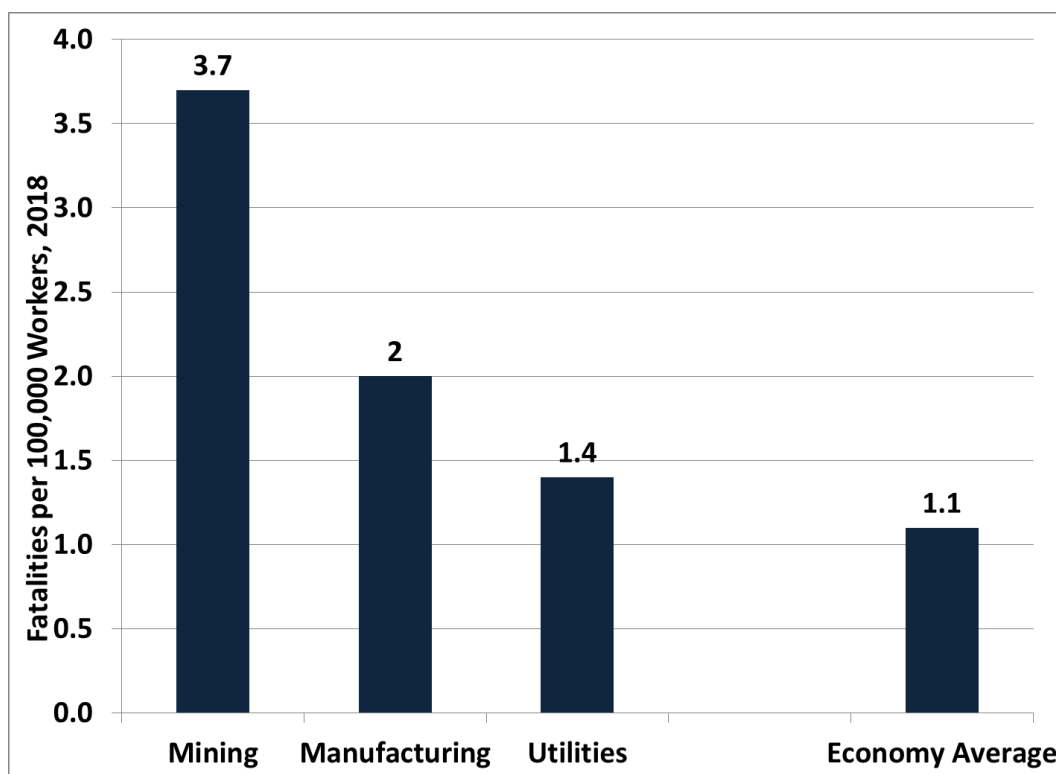


Source: Author's calculations from ABS Catalogues 6401.0 and 8155.0.

Health and Safety Risks: Fossil fuel jobs carry inherent health and safety risks, arising from challenging physical settings, the use of heavy machinery, and other features of the work. Those risks can be moderated by rigorous occupational safety practices, strong union representation, and better education and training. But the risks can be exacerbated, too: for example, by employer efforts to cut costs and enhance profits. Cost-cutting in the industry has definitely become more intense since global energy

prices turned down (after 2014). As indicated in Figure 12, fatality rates and other safety indicators are significantly worse in the broad sectors which encompass fossil fuel employment (mining, manufacturing and utilities). Average fatality rates in mining, for example, are more than three times higher than in the economy as a whole.

Figure 12: Workplace Fatalities, 2018



Source: Safe Work Australia (2019).

While improvements in technology and safety practices should steadily reduce injury and fatality rates over time, unfortunately the reverse has been the case recently in many fossil fuel occupations. The mining sector, in particular, has experienced a surge in fatalities and serious injuries in recent years. Queensland mines, for example, have experienced the worst rash of fatalities in at least two decades.²⁹ This prompted the Queensland government to commission a detailed inquiry into safety practices in mining; its report concluded that the elevated level of fatalities was likely to continue without urgent changes in industry practices.³⁰

Displacement: Employment in fossil fuel industries will inevitably decline in future as a result of contracting global demand for coal, petroleum, and natural gas. Because of climate policy and the increasing availability of cheaper renewable energy, global use of fossil fuels will fall, and prices for fossil fuels will also sink. That will inevitably affect future employment in fossil fuel industries in Australia, no matter what climate policies we pursue domestically. Since most fossil fuels produced in Australia are exported,

²⁹ See Smyth and Hume (2020).

³⁰ See Brady (2019).

those negative trends in foreign fossil fuel consumption will dominate the outlook for the Australian industry.

However, that existential threat to existing fossil fuel work is being exacerbated considerably by changes in the *domestic supply structure* of the fossil fuel industry. Because global demand for fossil fuels will decline, proposed projects that would *increase* Australian output and export of fossil fuels, to be sold into a shrinking global market, must undermine other, existing sources of fossil fuel supply – including those in Australia.

This problem will be acute in Australia’s coal industry. Proposed new mines in the Galilee coal basin in Queensland (including the Adani project) would substantially increase the supply of Australian coal, to be sold mostly into the global market. There is not enough global demand to absorb that new production; to the contrary, coal consumption will decline substantially in coming years due to the cancellation of new coal-fired electricity facilities in many countries, and the accelerating expansion of renewable generation. If those Galilee projects go ahead, they will enforce a commensurate decline in production from other supply sources – including from existing coal mines in Australia (which are typically older, higher-cost facilities, and hence will not be competitive with lower-cost supply from Galilee).

Independent analysis by consultants Wood McKenzie suggests that the planned growth of output from new projects in Galilee would reduce output from *existing* coal mines in Queensland and NSW by a combined total of some 115 million tonnes per year by 2035.³¹ That loss in production in turn would reduce coal mining employment in those regions by as many as 13,500 positions – about one in four existing Australian coal mining jobs.³² In fact, the loss of work in existing mines would more than offset the modest number of jobs created in the new projects. This imbalance is made worse because the larger, more efficient Galilee mines would embody more modern, capital-intensive technology, including full automation of many functions, and hence would support relatively few new jobs. The ironic result, therefore, would be a decline in total Australian coal mining employment, even as production and exports grow. Again, the claim that these projects must be approved to ‘create jobs’ in the mining sector is precisely opposite to reality: they will reduce total mining employment, not increase it. And by attracting new workers into relatively remote regional communities, these projects would certainly worsen the adjustment problems that will inevitably be encountered when that production ultimately shuts down.

³¹ See Long (2017).

³² Calculations in Murray, Browne and Campbell (2018).

* * * * *

For all of these reasons, therefore, existing workers in fossil fuel industries already face an uncertain and in many ways pessimistic employment outlook – and not because of domestic climate policy. The quantity of total employment in these industries will not grow, regardless of what climate policies are pursued by Australia: the dominant foreign customers for our fossil fuels are reducing their demand for our fossil fuel production. For years employers in these industries have been aggressively suppressing labour costs, destroying and devaluing existing work. The hope that fossil fuel jobs can somehow remain a ‘pillar’ of working class prosperity in Australia has already been disproven. Compassion and solidarity for the workers currently performing those jobs is best directed at protecting the wages and conditions of existing work (including protecting existing domestic jobs that would be displaced by new domestic mines), facilitating an orderly and well-supported long-run transition to other jobs, and discouraging young workers from entering an industry with an inherently short lifespan. Pretending that delaying this inevitable energy transition could somehow help workers whose jobs are already disappearing, both misleads workers into thinking their jobs can ultimately be saved – and diverts attention from the true source of their more immediate insecurity and exploitation (in particular, ruthless cost-cutting by their employers).

Planning an Orderly Transition

The preceding profile of the quantity, quality, and regional distribution of fossil fuel employment in Australia provides crucial context for developing strategies to ensure that the transition away from fossil fuels is managed effectively and fairly. There is no question that that transition away from fossil fuels will occur. It is not in Australia's power to stop the transition, since the rest of the world is moving ahead steadily with new policies and technologies to eliminate most demand for fossil fuel (including fossil fuels produced in Australia). What we can control is how the transition occurs. It can be planned, orderly, and fair – or chaotic, driven by others, and arbitrary.

As a country we can choose to recognise and prepare for that change, positioning ourselves to capture maximum benefits (both economic and environmental) from it, and support individuals and communities affected by it. Or we can choose to try to ignore what is happening, and maintain or even expand our fossil fuel footprint in hopes we can avoid the tectonic changes already happening. That will result in a disorderly and destructive transition: one where facilities and entire industries close suddenly and chaotically, when some final breaking point is reached and they can no longer economically function.³³

By committing to an orderly transition, we can start making the necessary decisions and investments to guide the shift to renewable energy sources. We can assist all stakeholders – businesses, workers, communities, public agencies – in preparing for that change, seizing opportunities associated with a renewables-led energy system, and positioning Australia as a leader rather than a laggard in the new industries that are emerging. We can also commit to systematically and fairly supporting and protecting individuals who will be most affected by the phase-out of fossil fuels: who will need to find new work (in new industries, occupations or regions), or transition to other stages of life (retirement or further education). We can also support those regions and communities (there aren't many) which depend heavily on fossil fuel industries today: helping them build the industries and attract the investments required to diversify and transform their local economies.

The preceding description of the stocks, flows and regional distribution of present fossil fuel employment immediately suggests several principles and best practices for

³³ Quiggin (2020) contrasts these two visions of transition (with a focus on the coal industry), and argues convincingly that transition will be less disruptive if it is planned and pro-active.

planning effective employment transitions. Here are the crucial policies that will be central to any successful transition plan (summarised in Table 5):³⁴

Table 5 Nine Principles for Effective Transition Planning	
1.	Commit Now to a Long-Term Phase-Out of Fossil Fuels
2.	Stage Transitions Over Time
3.	Facilitate Intra-Industry Mobility
4.	Encourage Voluntary Exit
5.	Support for Re-Skilling and Relocation
6.	Income Protections for Affected Workers
7.	Vibrant Macro-Economic and Labour Market Management
8.	Support Regional Diversification
9.	Remediation and Clean-Up

1. Commit Now to a Long-Term Phase-Out of Fossil Fuels: The politically-motivated reversals and uncertainty that have paralysed Australian energy and climate policy over the past two decades have massively disrupted effective planning (by businesses, investors, and workers alike), and exacerbated the costs of ultimate adjustment. Fossil fuels will disappear as a major source of energy within the foreseeable future. Given that reality, it is unhelpful, and indeed cruel, to keep encouraging more workers – including some just entering the workforce – to build their livelihoods in an industry that will soon disappear. As we have shown above, most of the coming decline in fossil fuel employment can be absorbed through normal attrition and retirement. But that only works if those normal departures are not replaced with new hires. A firm and clear signal must be sent to all stakeholders in the industry, most importantly to future workers, that the fossil fuel industry is disappearing. This will require overcoming vested opposition from narrow political and economic quarters, who still hope against hope they can preserve an industry that has been very profitable for them, but cannot continue. By confirming the long-run trajectory of decarbonisation, and communicating it clearly to all stakeholders, needless waste and cost will be avoided in the future.

³⁴ For a more comprehensive discussion of principles and best practices in transition planning, please see Stanford (2017).

The closure of the Hazelwood coal-fired electrical generating plant in Victoria's LaTrobe Valley in 2017 is an example of the unnecessary transition costs that result from a lack of clear, transparent phase-out planning. Even though the future operating life of that facility was known to be limited, the facility's owner (Engie) continued to hire new workers – even relocating them to the Gippsland region of Victoria – until just months before the closure was announced. The public announcement of closure was then made only 5 months before the facility was shut down. The company was reluctant to announce closure earlier, in part because of private commercial considerations (arising from potential impacts on prices in the commercial power market). This lack of transparent advance notice massively increased the cost of transition, and imposed completely avoidable disruption on fossil fuel workers, their families and communities. While important transition supports were subsequently put in place by the state and Commonwealth governments after the closure was announced, the sudden and last-minute nature of the company's action was needlessly disruptive. Private cost-benefit decisions surrounding closure of major facilities must be subordinated to the need for rational, fair and effective transition planning at the industry-wide level.

2. Stage Transitions Over Time: Time is the best friend of well-planned structural transitions: the longer the transition can be planned in advance, and the more gradually it is implemented, the more easily can its negative effects be managed and ameliorated. So in addition to announcing a firm long-term plan for the transition away from fossil fuels, it is also critical that closures be implemented steadily and gradually over time. Reaching net zero emissions by 2050 provides a long-term runway for shrinking these industries to zero. So long as the phase-out occurs evenly (and is not back-loaded with continuing delays and denial), that implies an annual reduction in fossil fuel employment of just a few thousand jobs per year – most of which could easily be absorbed through retirements and voluntary severance. That employment transition would be barely noticeable in a labour market that comprises 13 million working people, one-third of whom experience some major change in their employment activity every single year.

3. Facilitate Intra-Industry Mobility: The potential benefits provided by the normal flow of retirements and voluntary departures can be harnessed most powerfully, when the transition plan allows for mobility for fossil fuel workers across existing facilities and locations within the same industry. In essence, when a single facility closes, a proportion of its workers will be eligible to move into retirement or some other voluntary transition; this reduces the number of involuntary departures which must occur. But if worker mobility is allowed across locations, then younger workers (who cannot yet qualify for early retirement) could move to another facility or location that

continues to operate, filling vacancies opened by retirements or voluntary departures from that workplace. In fact, the number of such vacancies (at facilities that continue to operate) can be enhanced through early retirement and voluntary severance incentives offered to senior workers at *all* locations (not just those imminently closing).

This intra-industry mobility allows the downsizing of an overall industry to occur in a gradual, rational manner, with minimum involuntary displacement. It has been crucial in the successful experience of previous industry-wide shut-downs achieved in Germany, Ontario, and other jurisdictions (described in more detail below). But the strategy requires a capacity to plan closures and facilitate worker mobility at an industry-wide level. When an industry is owned by one large firm (such as a public utility), this is readily achievable. It is more challenging in the case of industries that are structured around competitive, fragmented private businesses. In that case, establishing some form of supra-firm planning and transition authority (such as Victoria's Latrobe Valley Worker Transfer Scheme³⁵) can facilitate the needed degree of integrated planning and mobility.

4. Encourage Voluntary Exit: Once a clear and firm timetable for phase-out of fossil fuel facilities has been established and communicated, most affected workers will immediately begin developing alternative plans for themselves and their families. The more these workers are able to anticipate and prepare for the phase-out, the smaller will be the ultimate involuntary displacement. Pro-active adjustment and mobility in advance of final closures can be accelerated through the early provision of incentives and supports for personal transitions of all kinds. These incentives will reinforce individuals' decisions to accept alternative opportunities. They could include packages for early retirement; incentives and 'buy-outs' for other voluntary severance; income protection for people moving to other positions with potentially lower wages; and paid leave and financial support for retraining or enrolment in higher education.

5. Support for Re-Skilling and Relocation: For some workers who transition from fossil fuel jobs to alternative industries or occupations, new skills and training will be required. This is not a problem for many fossil fuel workers: in many cases (including many technical, trades, management and professional occupations), workers' existing skill sets will be readily transferable to alternative applications. In other cases, however, access to retraining and continuing education can facilitate movement to new occupations and industries.

Retraining is often held out as a 'magic bullet' solution for structural adjustment situations, but it is rarely backed up with genuine resources and quality opportunities.

³⁵ See Minister for Jobs, Innovation and Trade (2017).

For retraining to play its potential role, fiscal investments in our vocational training system must be substantial and consistent. An economy-wide strategy for transitioning away from fossil fuels must be accompanied by urgent action to repair and strengthen Australia's battered TAFE system (damaged by years of underfunding and failed experiments with market delivery of vocational education³⁶), and generous support for tuition and living costs for fossil fuel workers undertaking retraining.

A similarly generous approach will also be required to support regional relocation by affected workers. As noted above, there are a few regional communities in Australia (not many) which depend heavily on fossil fuel jobs. Planning for the phase-out of fossil fuels will require targeted regional support for diversification and job-creation in those communities (discussed further below). Nevertheless, some workers and their families affected by the phase-out will opt to relocate to other parts of Australia. Financial support for relocation (including moving and resettlement costs, and compensation for the potential impacts of fossil fuel closures on housing and property prices in some communities) will further lubricate this process of regional mobility.

6. Income Protections for Affected Workers: Even with advance planning, phased closures, and support for redeployment and relocation, some workers in fossil fuel industries may still confront a loss of income resulting from the closure of their workplace. That may even be true for workers who successfully find alternative employment in other industries or occupations – but whose new jobs do not offer equivalent compensation. These workers should be provided with transitional income protection, to compensate for losses experienced as a result of a broader policy decision (namely, phasing out fossil fuel production) that benefits society as a whole.

Financial investors and business owners expect and regularly receive this sort of compensation: when a policy decision by government alters the viability or profitability of their investments (perhaps because it resulted in the 'stranding' of fixed capital assets), compensation to owners is routinely paid. In the case of energy transitions, such compensation to owners will likely be substantial (given the expensive capital assets used in most energy industries). The same principles of fairness should apply to affected workers, as well. Given the small number of workers employed in fossil fuel industries, and the potential to manage most transitions through retirement, redeployment and voluntary severance, the costs of even a generous income-protection scheme would be modest.

³⁶ See Carney and Stanford (2018) for more details on how the TAFE system could be strengthened to address skills shortages in many industrial settings.

A striking analysis of the modest cost of even strong income guarantees for transitioning fossil fuel workers was provided by U.S. economists Robert Pollin and Brian Callaci (2016), who modelled a comprehensive fossil fuel transition plan for the U.S. economy. Their proposed plan includes an income protection guarantee, guaranteed pensions, retraining grants, and other transition supports. They project an annual loss of employment of about 16,500 positions per year over 20 years in the U.S. from the gradual phase out of coal, petroleum, and ancillary industries in the U.S. They estimate that 83% of those job losses could be offset through retirement and attrition. Redeployment, retraining, and a 5-year 100% income guarantee for remaining workers would cost an average of only \$600 million per year for the whole country – very small relative to other costs associated with the coming energy transition.

7. Vibrant Macro-Economic and Labour Market Management: Any employment transition is easier to absorb, when the overall strength of employment conditions is reinforced through a top-priority commitment to reducing unemployment and supporting job-creation. Thanks to the strong labour market conditions that prevailed through the initial decades of the postwar era in Australia, enormous transitions in the composition of employment (including large shifts away from rural communities, and the rapid expansion of whole new industries) occurred with relatively modest dislocation and hardship. Commitment to enhancing the quantity of jobs must also be matched with a multi-dimensional emphasis on lifting the *quality* of work: including higher minimum labour standards and conditions, more secure and stable working hours, steady improvements in wages, and opportunities for collective representation.³⁷ When workers are presented with a range of appealing employment opportunities, their concern and resistance to the potential loss of their current vocations is substantially moderated. It is only when good jobs are scarce, and workers feel that there is little prospect of attaining decent alternative employment, that they fight more desperately to hang onto existing jobs – even those with an inherently time-limited future.

8. Support Regional Diversification: As described above, fossil fuel jobs are not distributed evenly across Australia. Some communities are especially dependent on fossil fuel industries for their economic and employment base. There are not many of these communities (as described above, in only 11 communities at the SA3 level do fossil fuel jobs constitute more than 5% of total regional employment). And a surprising share of fossil fuel work (close to half) is located in large urban areas, where opportunities for employment transitions will be readily available. Nevertheless, special attention must be paid in any transition plan to supporting those regional

³⁷ ACTU (2020b) highlights the importance of ensuring high-quality wages, entitlements, and conditions in the growing renewable energy sector.

communities which will experience relatively larger employment losses from the phase-out of fossil fuels. Providing ample notice of coming transitions will be especially important in those communities, to facilitate early preparation and adjustment. Above all, new workers should not be encouraged to move to those communities to take up new job openings – in industries with an inherently short time horizon.

A whole suite of potential industries could generate alternative employment prospects in regions which currently depend heavily on fossil fuel jobs. Remember, even in those 11 especially fossil fuel-dependent communities, an average of only 11% of local employment is located in fossil fuel industries. Health care and social services is just as important an employer, even in fossil fuel-dependent communities; continuing growth in that sector (which is growing faster than fossil fuel industries will shrink) will be hugely helpful to future labour market adjustments. Other public services (such as education, public administration, safety, and transportation) can also be vital sources of high-quality employment in these regions. Private sector industries (including agriculture, non-fossil-fuel mining, manufacturing, construction, and business services) can also contribute to the revitalisation of investment and job-creation in these regions.

Targeted government support for job-creation in these regions can aid the coming employment transitions. That can include expansion of direct public sector investments and hiring in targeted regions, to deliberately offset declines in fossil fuel employment. It can also include fiscal supports and other policy aid for private sector projects in regional communities, including special tax incentives or co-investments, R&D and training supports for expanded private ventures, and special provisions for development approvals and levies.

9. Remediation and Clean-Up: The closure of fossil fuel production facilities often leaves behind significant local environmental damage – including the need to repair land, water and waste pollution, and safely decommission old equipment (including mines, wells, and plants). The work involved in post-closure remediation can be of significant value in facilitating employment transitions for workers formerly employed in those facilities. And the work, once completed, improves local environmental conditions. Financially supporting this remediation work, and allocating it pro-actively to displaced fossil fuel workers (with full respect for seniority and prevailing wages and entitlements), should be required of fossil fuel companies and governments.

* * * * *

A helpful application of transition principles like these is provided by the Australian Council of Trade Unions' plan (ACTU, 2020a) for a fair transition for workers in fossil fuel-powered electric generation stations (and associated mines). The ACTU plan

identifies several core principles to ensure a just and effective transition for workers and communities affected by the coming closure of coal-fired generation stations, including:

- A commitment to no forced redundancies by power station operators.
- Lengthy and enforceable notice periods.
- Comprehensive and funded mine and power station site rehabilitation plans.
- Funding and support to retrain power station and mine workers.
- Funding and support to diversify the regional economies of affected regions (with public investments in infrastructure, education facilities, relocation of government services, training programs and industry development policy).
- Better valuing the work of female-dominated industries, to support family incomes and life the quality and compensation of jobs in alternative industries.

This list of principles is fully compatible with the framework discussed above. This approach highlights the importance of long-run planning, active intervention by governments (with income supports, transition assistance, and public investment), and commitments by employers to meeting critical benchmarks (including no involuntary redundancies).

Successful Transitions Around the World

The eight principles identified above for successful transition planning are not ‘rocket science’: it is self-evident, once the timetable for fossil fuel phase-out has been confirmed, and the underlying adjustment capacity of labour markets has been engaged, that orderly employment transitions can be facilitated without undue hardship for the industry’s existing workers. There are numerous examples of successful transition programs that have facilitated the phase-out of fossil fuel sectors in other countries. These experiences confirm that through the combination of advance notice, phased shut-downs, intra-industry mobility, and generous support for retirement and redeployments, fossil fuel industries can be completely retired without redundancies, mass unemployment, or undue community hardship. These successful real-world examples prove that a fair and orderly transition away from fossil fuels need not be disruptive or painful; done right, it can leave the economy (as well as the environment) much stronger.

Germany: The planned closure of black coal mining in Germany occurred over a 20-year period, and was completed in 2018. It provides an outstanding example of the advantages arising from advance notice, staged closures, and support for retirement and mobility.³⁸ The industrial regions of the Ruhr and Saar valleys in Germany had long been heavily dependent on coal mining and related activities. Employment in those industries was shrinking for decades, due to new technology and competition from other fuel sources. Ownership of the mines was consolidated (with public equity participation) in 1969 in a new integrated firm, RAG Aktiengesellschaft, to facilitate planned restructuring and also promote diversification into other industries. In 1997 a ‘Coal Compromise’ was reached, involving the company, the federal and state governments, unions, and affected communities. The Compromise ended subsidies for coal mining, and initiated the gradual close-down of the whole industry. Employment fell from 81,000 jobs in 1997 to just 2,000 when the last active mine closed. Most of the downsizing was accomplished through retirement of miners, supported by strong incentives for those younger than normal retirement age. Over 10,000 workers were also reassigned in the course of the phase-out to work in other locations, after their own mines closed. Strong supports were provided for retraining and redeployment to other jobs in RAG (including its growing non-mining divisions) and external firms in

³⁸ For more details on the German transition, see Sheldon et al. (2018) and O’Malley (2019).

other industries. Germany's very strong apprenticeship and job placement system assisted in this process. The orderly shut-down of this major regional employer thus occurred without undue damage to regional or national labour markets. Similar strategies are now being employed in a parallel plan to close down coal-fired electricity generation plants in Germany (and associated lignite mines) by 2038 or sooner. A transition and regional development aid package worth €40 billion will facilitate those adjustments; thanks to the same combination of advance notice, staged closures, intra-industry mobility and generous support for retirement and voluntary severance, that shut-down will also occur without forced redundancies.

Ontario, Canada: Ontario is Canada's largest province, with a population of 14 million. It also completed the successful planned shut-down of all coal-fired electricity generation, without incurring a single forced redundancy for affected workers.³⁹ Between 2005 and 2014, the province's publicly-owned power utility, Ontario Power Generation, closed a total of 19 coal-fired generating units at 5 locations, with a combined generating capacity of 7,500 MW. The first closure was announced in 2001 (4 years in advance); a schedule for the remaining closures was announced in 2003. The closures were staged over a decade-long period to ensure continued stability in electricity supply, and to facilitate an orderly adjustment of affected workers. At peak, the coal-fired plants employed a total of approximately 2000 direct workers. Two of the coal-fired generating plants were converted to biomass production, preserving local employment. In the others, affected workers were offered alternative employment at other OPG locations, or generous early retirement and severance incentives (negotiated with the unions representing OPG workers). No involuntary redundancies were experienced. The shut-down of coal-fired electricity in Ontario still ranks as the largest single emissions reduction initiative completed in North America. Ontario's experience has informed a similar transition strategy for a nation-wide closure of coal-fired electricity in other Canadian provinces, which will be completed by 2030.⁴⁰

U.K. The U.K. has experienced one of the fastest reductions in greenhouse gas emissions of any industrial country in recent years (down 30% in the last decade), on the strength of a stable and bipartisan commitment to ambitious emissions reductions and roll-out of renewable energy sources. The U.K. was traditionally a major producer of both coal and petroleum, so the employment transitions associated with these policies have been important. In earlier years, the forced closure of regional coal pits (for economic, not environmental, reasons) without transition support (imposed in the

³⁹ For more details on the Ontario experience, see Ministry of Energy, Ontario (2015), and Harris, Beck and Gerasimchuk (2015).

⁴⁰ For details see Environment and Climate Change Canada (2019).

turbulent 1980s) provided a case study in negative employment transitions. More recently the transition toward renewable energy has been accomplished with more benign labour market impacts. An estimated 225,000 British workers are employed in renewable energy projects. Some projects – such as massive new offshore wind power developments – have directly re-employed workers formerly occupied in offshore petroleum developments. The U.K. transition strategy has not been as integrated or comprehensive as those in Germany or Spain,⁴¹ but overall labour market outcomes in the U.K. remained relatively healthy (with an unemployment rate of just 4.0%, and relatively fast wage growth) as the shift to renewable energy accelerated.

Spain: The Spanish government has announced a plan to close its remaining 10 coal mines over the coming decade, accompanied by a program of generous early retirement subsidies, job-creation in reclamation and remediation, and redeployment into renewable energy jobs.⁴² Any miner over 48 at the time their mine closes will be eligible for early pension; that is expected to offset at least 60% of the job losses. Younger workers can be redeployed into new work associated with closing the mines, reclaiming associated land areas and converting them into other uses. Others will be provided assistance to transition into new jobs in renewable energy and other alternative industries. The transition program should avoid forced redundancies for any of the industry's existing workforce (of about 2000 workers).

U.S. States: It is perhaps ironic that the American economy has experienced a very rapid transition away from the use of coal in electricity generation. U.S. coal use for power generation declined by almost half in 10 years after 2008,⁴³ and continues to decline rapidly despite the commitment of former President Donald Trump to try to rebuild the coal industry. This experience attests to the fact that competitive pressures clearly overwhelm ideological positioning in energy use decisions. The U.S. has no national-level transition plan to assist workers affected by this trend (and the U.S. federal government continues to pretend that it can reverse the decline in fossil fuel use). But pro-active policy measures enacted in several U.S. states have shown that these transitions can be accelerated, while supporting regional labour markets to make the inevitable transitions. For example, New York State has implemented a Clean Energy Standard that will ensure that 70% of electricity is generated from renewable sources by 2030, and that the electricity system is carbon-free by 2040.⁴⁴ The state's last coal-fired power plant closed this year (Prohaska, 2020). Major investments in

⁴¹ Friends of the Earth Scotland (2019) make several suggestions for a stronger employment transition programme.

⁴² See Neslen (2018) for further details.

⁴³ U.S. Energy Information Agency (2020).

⁴⁴ See New York State Energy Research and Development Authority (2019) for more details.

renewable energy developments – including \$7 billion (U.S.) in tenders announced this year for on-shore, offshore, and port-based energy projects – are tied to project labour agreements that provide for training and targeted hiring for dislocated workers. Washington State has also committed to a 100% renewable electricity supply by 2045 under its new Clean Energy Transformation Act, which also features an emphasis on job training and adjustment measures.⁴⁵ Several other U.S. states have also enacted ambitious clean energy transition plans, that typically feature a significant role for labour training and adjustment measures, and have won support from labour advocates and unions.

Australian Examples: To date, Australia’s inconsistent and erratic policy framework for climate and energy has badly undermined the potential for effective transition planning. With significant sections of government and the fossil fuel industry still trying to prevent a transition away from fossil fuels at all, it becomes nebulous to try plan that transition in a more orderly and fair manner. This increases the chances that the coming transition will be chaotic, last-minute, and needlessly painful – as exemplified, for example, in the sudden decision by private power operator Engie to close its Hazelwood coal-fired plant in Victoria in 2017 (with hardly any notice at all, and driven by private profit-and-loss considerations not an industry-wide phase-out plan). However, even Australian experience provides some hints of how transitions could be better managed. The Victoria state government responded to the Hazelwood events with an ambitious package of transition supports, including a novel worker transfer scheme (allowing some workers at Hazelwood to move to other plants in the region), the creation of a Latrobe Valley Authority to finance various development and job-creation initiatives in the region, and a Mine Rehabilitation Commission to sponsor remediation work.⁴⁶ The upcoming closure of AGL’s Liddell coal-fired generation plant in NSW⁴⁷ will be facilitated by an agreement with the union there to avoid redundancies through voluntary severance incentives (including early retirements) and the redeployment of remaining workers to alternate work at the site or nearby locations (including AGL’s battery, pumped hydro, and gas generation operations).⁴⁸ Other examples of regionally-concentrated industrial adjustment (such as the closure of steel-making production in Newcastle, NSW in the 1990s, or the automotive closures in Victoria and South Australia in the 2010s) show the potential of pro-active transition planning and regional diversification projects to reduce dislocation and

⁴⁵ See Bernton and Brunner (2019) and Washington State Department of Commerce (2019) for more details.

⁴⁶ See Minister for Jobs, Innovation and Trade (2017) and Cain (2019) for summaries.

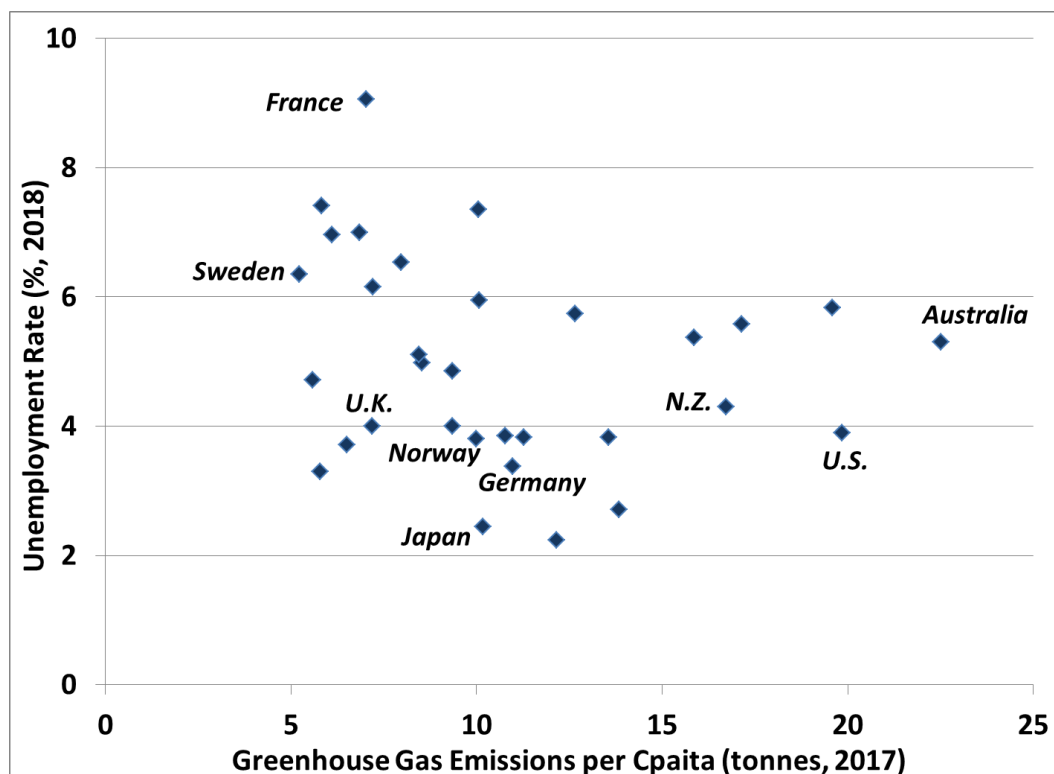
⁴⁷ Some political figures are still trying to delay that closure, for purely political reasons and contrary to the preferences of the plant’s owner.

⁴⁸ See CFMEU Mining and Energy (2017).

accelerate adjustment. The partial success of these examples should inspire a more comprehensive and consistent approach to planning employment transitions as the shift away from fossil fuels gathers momentum.

In addition to these specific global examples of successful employment transitions away from fossil fuels, international empirical evidence confirms that there is no negative association between emissions reduction (based on expanded renewable energy) and overall labour market performance. Figure 13 compares the level of greenhouse gas emissions (per capita) for numerous industrial countries, against the unemployment rate each recorded in 2018. Australia is located at the far right end of the figure (since it has such uniquely high GHG emissions per capita). All other industrial countries have lower emissions. Of those, many demonstrated lower unemployment rates than Australia in recent years (including the U.S., Japan, the U.K. and Germany). Many others have higher unemployment rates than Australia. Overall, there is no statistically significant correlation at all between emissions and unemployment. There is thus no international evidence that delaying the transition away from fossil fuels can somehow ‘save’ jobs; more likely, by discouraging innovation and exacerbating adjustment costs, such delays will be harmful for labour markets.

Figure 13: Greenhouse Gas Emissions and Labour Market Performance



Source: Author's calculations from OECD Greenhouse Gas Emission and OECD Labour Force Statistics.

In sum, the evidence is overwhelming that the transition away from fossil fuels, and the shift toward a lower emissions economy, can and must be accomplished while maintaining strong labour market performance, and generously supporting affected workers and communities. That happy combination will best be achieved through a combination of a forceful and consistent commitment to the phase-out of fossil fuels, combined with ambitious supports to facilitate transition, create new jobs (across the whole suite of industries, not just in renewable energy functions), and improve job quality for all workers.

Good Alternative Jobs: Where Will They Come From?

There is a common and understandable tendency in discussions of the employment effects of climate policy to directly link the disappearance of jobs in fossil fuel industries with the creation of new jobs in renewable energy industries. To be sure, the roll-out of renewable energy projects will have important and positive employment effects. Indeed, because fossil fuel industries are highly capital-intensive, and not very effective at generating work (for given quantities of output), most studies find that the shift from fossil fuels to renewable energy will have a net positive employment impact.⁴⁹ The new employment opportunities associated with renewable energy systems will make an important contribution to the labour market transitions associated with the phase-out of fossil fuels.

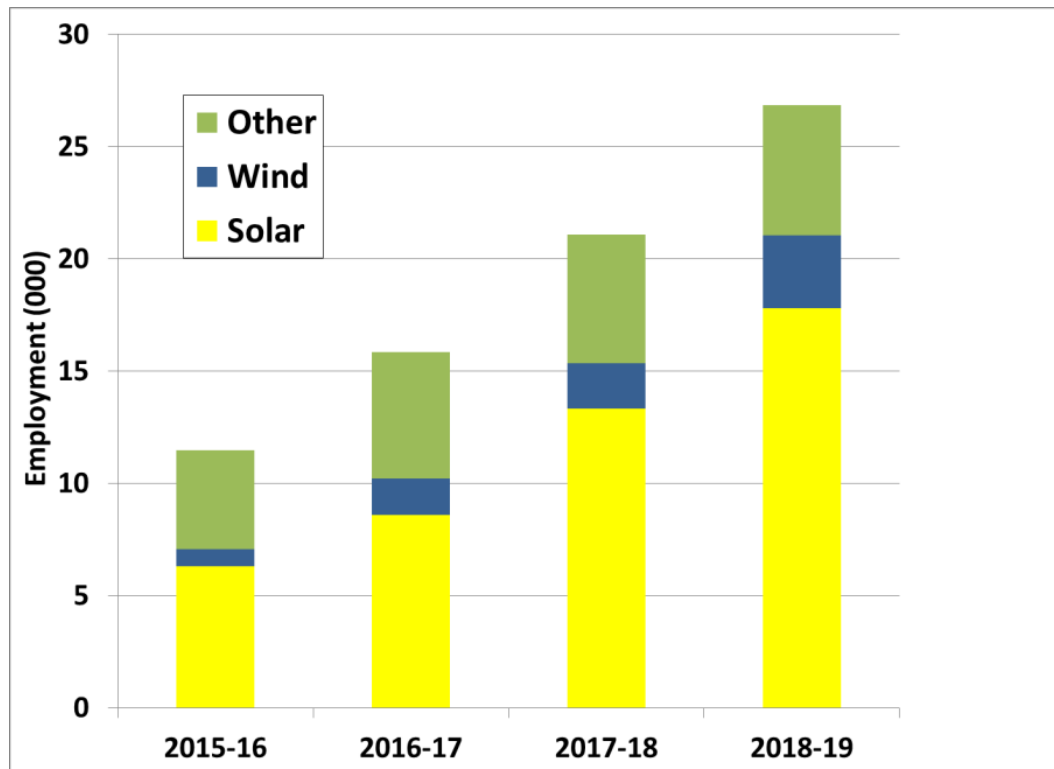
However, it is a mistake to limit consideration of the employment effects of the energy transition just to those two energy sectors: one growing, one disappearing. As we have seen, the Australian labour market constantly experiences an ongoing, powerful process of adjustment, visible every month, through which workers transition across jobs, occupations, industries and regions. That process involves all sectors of the economy. There is no reason to expect that shifting fossil fuel workers toward renewable energy jobs will be the only, or even an especially important, dimension of the employment adjustment to the phase-out of fossil fuels.

In Australia, the renewable energy industry continues to expand (despite the uncertainty and inconsistency of climate and energy policy in recent years), generating parallel growth in direct employment. Total employment increased by 135% in the three years ending in 2018-19, to a total of around 27,000 jobs. Positions in solar installations and maintenance account for two-thirds of that total, although wind-related projects and other renewable energy roles are also growing rapidly. The Clean Energy Council (2020) projects 20,000 new jobs to be created in renewable energy systems by 2025. And these statistics understate total employment in renewables, since many jobs associated with renewable energy work are located within larger and diverse businesses and agencies (such as electricity supply, manufacturing, and

⁴⁹ For example, see Hoffman (2017) and Garret-Peltier (2017). Garret-Peltier estimates that the integrated employment effects of investments in renewable energy systems are three times greater than for equivalent investments in fossil fuel systems.

construction firms), which are counted in other sectors of the economy (rather than renewable energy).

Figure 14: Employment in Renewable Energy Industries



Source: ABS Catalogue 4631.0.

Despite the encouraging growth of employment in renewable energy, however, it is not essential that new jobs there must equal or exceed current jobs in fossil fuel industries. And it is certainly not necessary that individuals currently employed in fossil fuel occupations should primarily seek reemployment in renewable energy projects. As we have seen, the labour market is a complex, interrelated system. Jobs are created and destroyed constantly across the full range of industries that make up the economy. And individuals make transitions in all sorts of directions: in and out of the labour force, in and out of employment and unemployment, changing their hours, occupations, and industries. What matters is that the overall pace of job-creation, across the full set of industries and regions, be sustained at a healthy and consistent rate. Combined with timely support for individuals and regions who face especially big transitions, that will ensure that the transition away from fossil fuel employment is managed efficiently and fairly.

Indeed, as we have shown, most existing fossil fuel workers will not need to switch to another job at all, so long as the phase-out of fossil fuel production is announced and

planned well in advance, and closures are staged at sensible increments. The experience of other jurisdictions confirms that under these conditions, most affected workers simply retire when their normal working lives are over (or almost over). In the successful German, Canadian and Spanish transitions, few fossil fuel workers needed to find alternative work. Instead, a well-planned and well-staged transition allows them to exit voluntarily. The essential complement to this strategy is to ensure that their former positions are not filled by a new generation of younger workers – who then would bear a needless burden of subsequent adjustment costs.

For those fossil fuel workers who do seek alternative vocations, they will have a wide choice of industries and occupations in which to seek employment. Since the labour market incorporates ongoing flows and adjustments across all of its constituent segments, it is not possible to ‘assign’ displaced fossil fuel workers to any particular destination. And since the labour market creates a far larger number of new jobs across the whole range of industries and occupations than could conceivably be displaced from fossil fuel industries (under any reasonable phase-out timetable), there is no question that there will be enough ‘alternative jobs’ to absorb those fossil fuel workers who wish to find alternative work.

The diversity and abundance of alternative employment prospects is summarised in Table 6. On the basis of federal government forecasts, it reports the annual rates of job-creation expected in several rapidly-growing sectors of the economy, as well as across several broad occupational groupings. Those flows of new jobs are then compared to the number of fossil fuel workers who are likely to need to seek alternative employment. We assume a 20-year timetable for the full closure of fossil fuel industries and occupations. As discussed above, that timeline implies an annual reduction in fossil fuel employment of 6,650 jobs per year. However, as also discussed, most of those disappearing jobs will correspond to the retirement of existing workers; examples of transition planning from other countries confirm that with sufficient notice and generous retirement incentives, most affected workers can move straight into retirement (rather than having to seek alternative employment). Therefore, Table 6 cautiously assumes that half of affected workers are able to move into retirement, and hence one-half the required annual decline in fossil fuel employment – or just 3,325 job per year – will be reflected in former workers seeking alternative employment.⁵⁰ Keep in mind that hundreds of times that many Australian workers change their employment status every *month*. So assisting 3,325 Australians to find

⁵⁰ In the German, Spain and Canadian examples, between 60 and 80% of existing workers were able to move directly into retirement, and hence the number of alternative positions truly required will almost certainly be smaller than assumed here.

new work in a year is a very small scale of adjustment, in the context of the overall functioning of a diverse, flexible national labour market.

Table 6 Federal Government Projections of Annual Employment Growth, 2019-2024 (thousand jobs per year)			
By Industry		By Occupation	
Health Care and Social Assistance	50.5	Professionals	82.3
Professional, Scientific & Technical	34.5	Community & Personal Service	44.7
Education and Training	25.9	Technicians & Trades	25.5
Construction	22.7	Managers	19.0
Accommodation and Food Services	18.3	Operators & Drivers	16.3
Retail Trade	12.5	Labourers	13.5
Public Administration and Safety	10.4	Sales Workers	9.0
Transport, Postal and Warehousing	8.7	Clerical & Admin.	4.8
Annual Displacement of Fossil Fuel Workers: 3.3¹			
Source: Author's calculations from Dept. of Employment, Skills, Small and Family Business (2019).			
1. Assumes 20-year phase-out of industry; 50% jobs absorbed via retirement.			

As indicated in Table 6, there are many industries and occupations which will single-handedly experience far more job-creation every year than needed to absorb the entire annual flow of workers displaced from fossil fuel industries over a 20-year timetable. The growing health care and social service sector alone will create 15 times as many jobs each year as would be displaced from fossil fuel industries, under the preceding assumptions. Of course, workers seeking a new career will need to possess the right skills, and be in the right location, for those new jobs – and that is why generous retraining and relocation supports will be needed to ease their transition. But even in the few regional communities that depend on fossil fuel employment for a truly significant share of local employment, the pace of job-creation across the full suite of other industries will be more than sufficient to absorb the portion of displaced fossil fuel workers who would actually be seeking alternative employment (rather than transitioning into retirement or other opportunities). In most communities, local health care and social services alone will create more than enough new work to single-handedly absorb all displaced fossil fuel workers – let alone all the other job options which those workers could contemplate.

Part of the challenge of planning an orderly and effective transition is also to ensure that alternative jobs for former fossil fuel workers possess attractive features: such as decent compensation, stable hours and tenure, and collective representation. At present, many fossil fuel jobs offer above-average compensation levels – although, as

noted above, this largely reflects very long hours and often unpleasant aspects of the jobs (such as remote work, work under harsh physical conditions, fly-in fly-out arrangements, and other challenges). Moreover, fossil fuel jobs have also been degraded over time by aggressive cost-cutting by employers: through labour hire and contracting-out practices, real wage cuts, and deteriorating health and safety outcomes. Protections provided by union representation and enterprise agreement coverage have also been eroded over time in fossil fuel industries, contributing to the erosion of compensation and working conditions.⁵¹ So the assumption that fossil fuel jobs are relatively 'good' jobs is no longer justified – if it ever was. Nevertheless, the higher average incomes typical of the sector raise a legitimate concern about the extent to which alternative employment will be able to replace those incomes, and offer decent, stable livelihoods. This concern makes it all the more important that in addition to prioritising strong job creation at the macroeconomic level, government also commits to labour law and industrial relations reforms aimed at improving the quality and stability of jobs across the economy.⁵² Measures which could accomplish this general improvement in job quality would include higher minimum wages, a strengthening and expansion of the Modern Awards system, and support for collective bargaining (which has eroded badly in recent years in most private sector industries).⁵³

⁵¹ In 2018, union density in the mining sector was 12.8% of total employment, and 11.8% in manufacturing, compared to 14.6% in the overall economy. And union density in both mining and manufacturing has declined more rapidly than in other sectors. Utilities is one fossil-fuels-related sector which has maintained relatively strong union density, at 29.4% in 2018. Calculations from ABS Catalogue 6333.0 (2018), Table 3.1.

⁵² ACTU (2020b) highlight the importance of commitments to high-quality, stable work in the renewable energy industry.

⁵³ An agenda of labour policy reforms aimed at lifting job quality in all sectors is described by Stanford (2019).

Conclusion: No Time to Waste

Many discussions about climate policy are imbued with a sense of urgency, and rightly so. Scientists have warned that humanity has a limited window of opportunity – perhaps a decade – to shift decisively onto a trajectory of rapid emissions reduction (followed quickly by the elimination of net GHG pollution). We must move quickly to stabilise the climate, limit warming, and avoid the catastrophic consequences of larger shifts in global temperature.

Our review of the employment aspects of the transition from fossil fuels, however, provides an additional, economic rationale as to why the transition must start sooner rather than later – and why we need a transparent, firm timetable to guide the retirement of fossil fuel industries. Labour market transitions are immensely more manageable and less costly when they are announced well in advance, and phased in gradually over time. That gives labour market participants ample time to react and plan their subsequent actions and adjustments. It warns younger workers not to build new careers in these industries – which have such a limited lifespan ahead of them. That avoids needless displacement in later years. And it allows the entire transition process to utilise the natural power of ageing: with appropriate notice and a gradual staging of shutdowns, most exits from fossil fuel employment can be achieved through voluntary retirement. With appropriate mobility and redeployment supports, forced redundancies can be avoided entirely.

So for the sake of fossil fuel workers, as well as the sake of the planet, the inevitable phase-out of fossil fuel production and use must be announced and confirmed quickly and firmly, and the process of wind-down commenced. This phase-out will be complemented, of course, by expansion of renewable energy technologies, with all of their economic spin-offs – including the creation of tens of thousands of new jobs. As we have seen, however, those new jobs in renewables will play at most a supporting role in an effective, orderly labour market transition. Most fossil fuel workers will not end up producing solar panels or windmills; in fact, if we manage this transition effectively, most fossil fuel workers will not need to find new jobs at all. As with the climate itself, the sooner we start this transition, the lower will its ultimate costs be, and the greater its net benefits.

Delaying these necessary actions only makes matters worse – including for fossil fuel workers themselves. In this context, supposed concerns for fossil fuel jobs invoked by some business leaders and political representatives are entirely dubious. Pretending that fossil fuel industries can carry on as ‘normal’ for decades, or worse yet can even

be expanded, is a cruel hoax. It would lead to tremendous disruption and needless cost for workers, including young workers, lured into an industry which will soon shut down. Indeed, this ‘concern’ for fossil fuel jobs and workers was always very selective, anyway. As we have seen, jobs in fossil fuel industries are insecure at the best of times, subject to unpredictable cycles of demand and powerful challenges that have nothing to do with domestic climate policies. Whenever coal and petroleum companies can profitably replace their Australian employees with automated technology, or outsourced labour hire arrangements, or foreign temporary workers, they do so without hesitation. Indeed, their attacks on the job security, wages, and working conditions of fossil fuel workers have become more intense in recent years, as employers try to fatten profit margins despite weakness in global commodity prices. So all Australians, including fossil fuel workers themselves, should be skeptical when opponents of climate and energy transition claim they are defending workers. Their solidarity is fleeting: invoked only when it coincides with the corporate interests of fossil fuel businesses.

Our statistical description of Australia’s labour market, and its powerful, ongoing capacity to adapt to change, confirms that a gradual phase-out of fossil fuel industries would be a modest and entirely manageable change in the overall world of work in Australia. The number of Australians employed today in fossil fuel jobs is small: 1% of total employment. The rise and (inevitable) fall of fossil fuel employment is utterly dwarfed by much larger forces shaping the labour market: including new jobs in much larger sectors (like health care and social services, professional and technical work, construction, and education). Many fossil fuel jobs are concentrated in a handful of regional communities, and this complicates the transition process. But even there, the vast majority of jobs are in other industries, including vibrant sectors like health care that will have more powerful impacts on the labour market in coming years than changes in fossil fuel employment. Hundreds of thousands of Australians – several times more than work in fossil fuel jobs – change their employment status every month. This capacity of Australian workers to change and adapt will be an enormous asset as our economy evolves toward a low-carbon future – just as they adjusted to other, larger employment shifts in our history.

The key to preparing for this inevitable change, and ensuring that it occurs in an orderly and fair manner, is time. Hence the phase-out of fossil fuels must be announced (and firmly committed to) well in advance. It must be enacted gradually, with staged reductions and closures – not back-end-loaded through deferrals and delays. Where possible, existing fossil fuel workers can rely on that time to complete their careers normally. But that only works if younger workers are not hired to replace them. They must not be lured under essentially false pretences into investing in a

career which cannot last for long. Supports for retraining, redeployment, relocation, and regional job-creation can ease the process further. The cost of these supports would be small, relative to the scale of the capital investments and other expenses that will also occur as part of the coming energy transition.

In short, there is absolutely no contradiction between eliminating Australia's current reliance on fossil fuels, and maintaining a strong labour market (with secure jobs, good working conditions, and rising wages). International experience confirms there is no connection whatsoever between labour market well-being and emissions intensity. Australia can negotiate the transition away from fossil fuel jobs as successfully as we negotiated previous, larger transitions. What is required is a firm, consistent commitment to do so, and the provision of meaningful support to make the transition effective, steady and fair.

References

- ACIL Allen Consulting (2019). *The Transition of the Australian Car Manufacturing Sector: Outcomes & Best Practice Summary Report* (Canberra: Department of Employment, Skills, Small and Family Business).
- Australian Bureau of Statistics (2020). "Spotlight: People Moving Into or Out of Employment or Unemployment Every Month," *Labour Force*, March.
- Australian Council of Trade Unions (2020a). *A Technology-Led Plan Without a Destination*, ACTU Submission to Australia's Technology Investment Roadmap review (Melbourne: ACTU), June.
- Australian Council of Trade Unions (2020b). *Sharing the Benefits with Workers: A Decent Jobs Agenda for the Renewable Energy Industry* (Melbourne: ACTU), November.
- Beach, Ruth, David J. Brereton, and David I. Cliff (2003) *Workforce Turnover in FIFO Mining Operations in Australia: An Exploratory Study* (Brisbane: Centre for Social Responsibility in Mining and Sustainable Minerals Institute, University of Queensland).
- Bernton, Hal, and Jim Brunner (2019). "Clean power is now the law; Inslee signs bill for zero-carbon electricity by 2045," *Seattle Times*, 8 May.
- Bodhar, Paul, et al. (2020). *How to Retire Early: Making Accelerated Coal Phaseout Feasible and Just* (Basalt, CO: Rocky Mountain Institute).
- Business Council of Australia (2019). We support strong action on climate change (Melbourne: Business Council of Australia), https://www.bca.com.au/energy_and_climate.
- Cain, Karen (2019). "A just transition for the Latrobe Valley," Latrobe Valley Authority, March, <https://www.climate-transparency.org/wp-content/uploads/2019/03/17.Karen-Cain-Latrobe-Valley-Authority-February-2019.pdf>.
- Carney, Tanya, and Jim Stanford (2018). *Advanced Skills for Advanced Manufacturing: Rebuilding Vocational Training in a Transforming Industry* (Sydney: Centre for Future Work).
- CFMEU Mining and Energy (2017). "AGL Liddell Plan Ensures Job Security for Over 300 Workers," 12 December, <https://me.cfmeu.org.au/news/agl-liddell-plan-ensures-job-security-over-300-workers>.

Clarke, Jo (2020). "Glencore may shut 4 Australia coal mines," *Argus Media*, 8 December, <https://www.argusmedia.com/en/news/2166877-glencore-may-shut-4-australia-coal-mines-clarification>.

Clean Energy Council (2020). *Clean Energy at Work* (Melbourne: Clean Energy Council).

Climate Action Tracker (2020). *Australia Country Summary*, <https://climateactiontracker.org/countries/australia/>.

Department of Employment, Skills, Small and Family Business (2019). *Employment Outlook to May 2024* (Canberra: Australian Government).

Department of Industry, Science, Energy and Resources of Australia (2020). *National Greenhouse Gas Inventory: September 2019* (Canberra: Australian Government).

Environment and Climate Change Canada (2019). *A Just and Fair Transition for Canadian Coal Power Workers and Communities* (Ottawa: Environment and Climate Change Canada).

Friends of the Earth Scotland (2019). *Sea Change: Climate Emergency, Jobs and Managing the Phase-Out of UK Oil and Gas Extraction* (Edinburgh: Friends of the Earth Scotland).

Frost, Lionel (2014). "Urbanisation," in Simon Ville and Glenn Withers (eds.), *The Cambridge Economic History of Australia* (Cambridge: Cambridge University Press).

Garnaut, Ross (2019). *Superpower: Australia's Low Carbon Opportunity* (Carlton: La Trobe University Press).

Garret-Peltier, Heidi (2017). "Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model," *Economic Modelling* 61(1), pp. 439-447.

Geck, Marshall (2019). "Seven Major Companies that Committed to Net-Zero Emissions in 2019," *Principles for Responsible Investment* (blog), 19 December, <https://www.unpri.org/pri-blog/seven-major-companies-that-committed-to-net-zero-emissions-in-2019/5255.article>.

Harris, Melissa, Marisa Beck and Ivetta Gerasimchuk (2015). *The End of Coal: Ontario's Coal Phase-Out* (Winnipeg: International Institute for Sustainable Development).

Hatton, Tim, and Glenn Withers (2014). "The Labour Market," in Simon Ville and Glenn Withers (eds.), *The Cambridge Economic History of Australia* (Cambridge: Cambridge University Press).

Heywood, Brady (2019). *Review of All Fatal Accidents in Queensland Mines and Quarries from 2000 to 2019* (Brisbane: Department of Natural Resources, Mines and Energy).

Hoffman, Allen (2017). "Jobs? Investing in Renewables Beats Fossil fuels," *Energy Post*, 19 May, <https://energypost.eu/jobs-investing-in-renewables-beats-fossil-fuels/>.

International Labour Organization (2015). *Guidelines for a Just Transition Towards Environmentally Sustainable Economies and Societies for All* (Geneva: ILO).

Kirkwood, Ian (2015). "The same job, the same shift ... for \$70k less a year," *Newcastle Herald*, 26 May.

Long, Stephen (2017). "Galilee Basin Mines Will Slash Coal Output, Jobs Elsewhere, Wood Mackenzie Says," *ABC News Online*, 5 July.

McGhee, Rachel (2020). "Hundreds of coal jobs lost as low coal prices, coronavirus impacts mining," *ABC News Online*, 18 June.

Minister for Jobs, Innovation and Trade, Victoria (2017). "Power Generators Commit To Worker Transfer Scheme," Government of Victoria, 1 May, <https://www.premier.vic.gov.au/power-generators-commit-to-worker-transfer-scheme/>.

Ministry of Energy, Ontario (2015). *The End of Coal* (Toronto: Government of Ontario), <https://www.ontario.ca/page/end-coal>.

Murphy, Katharine (2020). "Net Zero Emissions by 2050: Is it a Controversial Ambition and Will the Coalition Adopt It?," *The Guardian*, 24 February.

Murray, Cameron, Bill Browne, and Rod Campbell (2018). *The Impact of Galilee Basin Development on Employment in Existing Coal Regions* (Sydney: Australia Institute).

Nahum, Dan (2020). *Powering Onwards: Australia's Opportunity to Reinvigorate Manufacturing through Renewable Energy* (Canberra: Centre for Future Work).

Neslen, Arthur (2018). "Spain to Close Most Coalmines in €250m Transition Deal," *The Guardian*, 27 October.

New York State Energy Research and Development Authority (2019). *Clean Energy Standard Annual Progress Report: 2018 Compliance Year* (Albany: NYSEDA), <file:///C:/Users/jims/Downloads/Case%2015-E00302%20CES%202018%20Annual%20Progress%20Report.pdf>.

O'Malley, Nick (2019). "How Germany closed its coal industry without sacking a single miner," *Sydney Morning Herald*, 14 July.

Perry, Martin, and James E. Rowe (2015). Fly-in, Fly-out, Drive-in, Drive-out: The Australian Mining Boom and its Impacts on the Local Economy," *Local Economy* 30(1), pp. 139-148.

Pollin, Robert, and Brian Callaci (2016). *The Economics of Just Transition: A Framework for Supporting Fossil Fuel-Dependent Workers and Communities in the United States* (Amherst, MA: Political Economy Research Institute), Working Paper 423.

Pollin, Robert, Heidi Garrett-Peltier, and Jeannette Wicks-Lim (2017). *A Green New Deal for Washington State: Climate Stabilization, Good Jobs, and Just Transition* (Amherst, MA: Department of Economics and Political Economy Research Institute, University of Massachusetts).

Prohaska, Thomas (2020). "New York's last coal-burning power plant closes on Lake Ontario shore," *Buffalo News*, 30 March.

Quiggin, John (2020). *Getting Off Coal: Economic and Social Policies to Manage the Phase-Out of Thermal Coal in Australia* (Canberra: Australia Institute).

Reserve Bank of Australia (1997). *Australian Economic Statistics 1949-1950 to 1996-1997*, Occasional Paper No. 8, Table 4.5.

Robinson, Keith, et al. (2015). "Relationships Between Children's Behaviour and Parents' Work Within Families of Mining and Energy Workers," *Journal of Sociology* 53(3), pp. 557-576.

SafeWork Australia (2019). *Key WHS Statistics Australia 2019* (Canberra: Safe Work Australia).

Shalal, Andrea (2019). "Germany to move ahead quickly on implementing coal exit," *Reuters*, 26 January.

Sheldon, Peter, Raja Junankar and Anthony De Rosa Pontello (2018). *The Ruhr or Appalachia? Deciding the Future of Australia's Coal Power Workers and Communities* (Sydney: University of New South Wales, Industrial Relations Research Centre).

Smyth, Jamie, and Neil Hume (2020). "Australia Mine Safety Crisis Spurs Workforce Debate," *Financial Times*, 9 March.

Stanford, Jim (2017). "Principles for Meaningful Transition Support for Workers in Carbon-Intensive Industries," Testimony, Senate of Australia,

[https://d3n8a8pro7vhmx.cloudfront.net/theausinstitute/pages/1431/attachments/original/1488436294/Stanford Testimony Senate Inquiry Coal-Fired Power.pdf?1488436294](https://d3n8a8pro7vhmx.cloudfront.net/theausinstitute/pages/1431/attachments/original/1488436294/Stanford%20Testimony%20Senate%20Inquiry%20Coal-Fired%20Power.pdf?1488436294).

Stanford, Jim (2019). "A Turning Point for Labour Market Policy in Australia," *Economic and Labour Relations Review* 30(2), pp. 177-199.

Swann, Tom (2019). *High Carbon from a Land Down Under: Quantifying CO₂ from Australia's Fossil Fuel Mining and Exports* (Canberra: Australia Institute).

Taylor, Charlie, et al. (2017). *Australia's Automation Opportunity* (Sydney: McKinsey and Company).

Toscano, Nick (2019). "Rise of the Machines: Why Australia's Miners are Racing for Automation," *Sydney Morning Herald*, 30 November.

U.S. Energy Information Administration (2020). "U.S. Coal Consumption by Major End Users," <https://www.eia.gov/energyexplained/coal/use-of-coal.php>.

Washington State Department of Commerce (2019). "Clean Energy Transformation Act: A Brief Overview" (Olympia: Dept. of Commerce), <https://www.commerce.wa.gov/growing-the-economy/energy/ceta/>.

Whelan, Stephen (2020). *Wage-Cutting Strategies in the Mining Industry: The Cost to Workers and Communities* (Sydney: McKell Institute).

Workplace Express (2019). "Gina's Inadequately Explained Rail Deal Approved via Undertakings," *Workplace Express*, 17 September.

Zhou, Vanessa (2019). "Queensland Puts FIFO Ban on Eight More Large Projects," *Australian Mining*, 26 July.